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# How Water Shut-Off Boxes Are Made

## On Account of the Thin Metal Sections Accurate Rigging is Necessary—Special Rotary Core-Making Machines are Employed—Flasks Strictly Interchangeable — Practice of a Buffalo Shop

SIR JOSHUA REYNOLDS, the great English painter, once showed a friend of his a painting which apparently was nearly finished. The friend returned several days afterward and found the artist still engaged upon the same piece of work. He expressed surprise and intimated that he did not understand what the artist had been doing those several days; to his eyes the painting looked the same as it did the last time he had seen it. Sir Joshua replied he had been quite busy; he had touched up a shadow here, a high light there, accented a line in one place, subdued one in another and changed a host of other details. His friend remarked that these things were only trifles. "My dear friend," said the eminent artist, "I would beg you to remember that a multitude of trifles makes perfection and perfection is no trifle."

### *Intelligence in Planning*

If trifles play such an important part in the individual work of a man who plans his own effort and then carries it out himself, how much more important are the trifles to be taken into consideration by the man who plans work for other men to carry out? This work may be divided among a great number of men, each one of whom makes one of the component parts, which are assembled later into a harmonious whole.

Intelligent planning of every detail of the prospective work is the most important feature in connection with any task, especially in turning out work on a production basis. If the preliminary planning is done thoroughly the subsequent steps in the prosecution of the work will present no difficulties. Time, labor and material will be in their alloted places at the proper time; they will blend harmoniously, and the result will amply justify any expenditure of time or money incurred in the preliminary preparation. Provided the original plans are practical and all the details have been carefully worked out

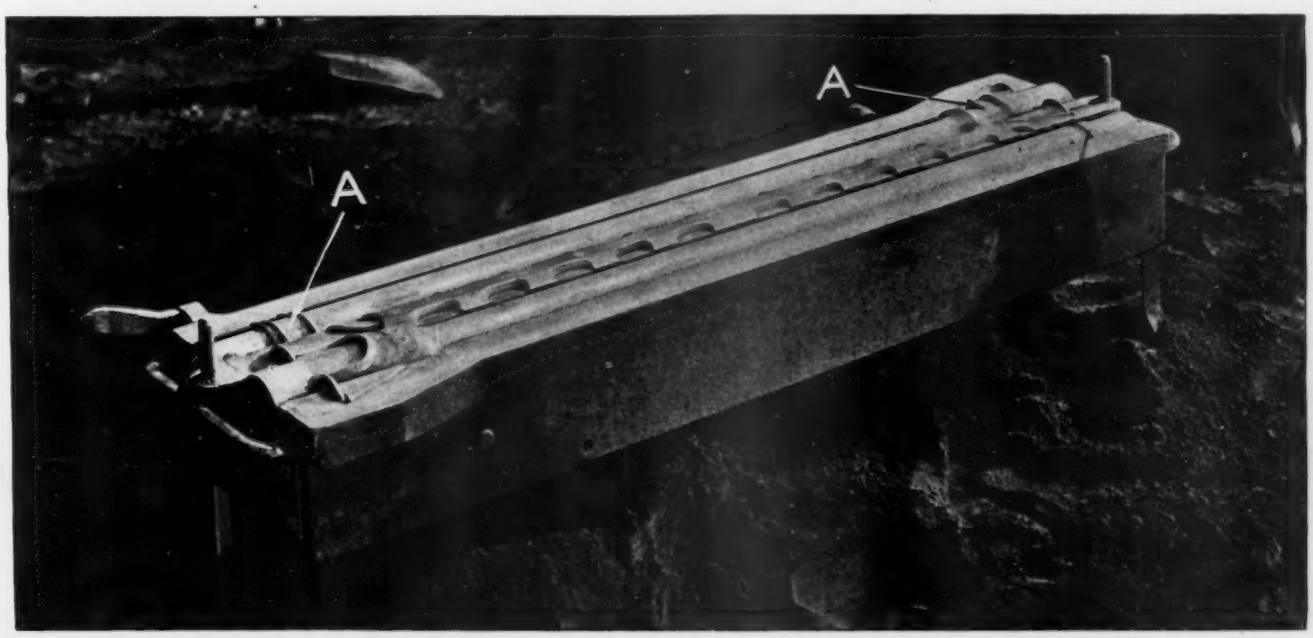


FIG. 1—STRIPPING MACHINE FOR SMALL PIPE—NOTE CONTINUOUS GATE FULL LENGTH OF PATTERN

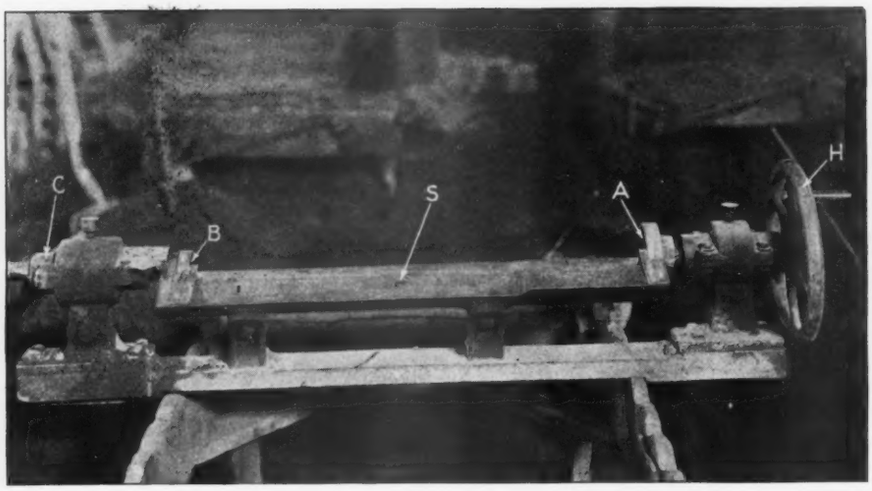


FIG. 2—THE DEVICE FOR HOLDING AND REVOLVING THE ARBOR—THESE MACHINES ARE MADE IN VARIOUS LENGTHS

the success of the system of production is assured.

A case in point is found in the methods and rigging adopted by Bingham & Taylor, Buffalo, for making small, light pipe. This company makes both gray iron and electric-steel castings and the shop is equipped to turn out 200 tons of iron and 20 tons of steel castings a day. Castings are made for railroad and general use but the company specialize in extension stop-cock and valve shut-off boxes for gas and water. These castings are supplied in several standard diameters and lengths. They are not sold on a per pound basis but at so much each and, therefore, they are made as light as possible. The metal sections in the smaller sizes are only 0.1-inch, while the larger sizes have metal thicknesses varying from ⅛ to ⅞ inch.

*Accurate Rigging is Necessary*

It will be readily appreciated that the rigging to make such work must be extremely accurate, for a shift of 0.05-inch either horizontally or vertically would mean a missrun casting. Various methods have been adopted by different foundries to make it certain that the component parts of a mold will fit in their respective places when the mold is closed. Some are so extremely simple, not to say primitive, that they require constant care on the molder's part to see that they function properly, while others are so elaborate that their high initial cost and subsequent repair expenses offset any advantages they may possess. The flasks used for the work under discussion may be described as standard inasmuch as the copes and drags are made from the same pattern. They are made as light as is consistent with safety in order to facilitate handling. The frames are ⅜-inch thick and the bars are ¼-inch.

Those flasks which are under four feet in length are provided with one lug on each side at the joint for clamping purposes. Flasks longer than four feet are provided with two lugs on each side. The copes are located on the drags by one guide pin at each end; these are laid out accurately on a center line and correspond to similar guides on the pattern plates on which the molds are rammed. These flasks have been in use now for many years and it is only necessary to provide a new cope or drag occasionally. When they were first fitted up they were made interchangeable by first adjusting a pair of lugs containing pin holes in the proper position on one drag. This was done by drilling three ¼-inch holes through both lug and flask at each end and inserting three bolts in each lug. The copes were then taken in turn and each one was provided with a pin. These pins, which had lugs cast on them in positions corresponding to the pin holes, were secured to the copes by three bolts in the same manner. After all the copes had been adjusted to fit one drag, the rest of the drags were taken in turn and fitted on the first cope. In this way the drag acted as a jig in the first case and the cope in the other, thus insuring interchangeability and absolute accuracy.

*Simple Matter to Renew Guides*

When in the course of time any of the pins or pin holes wear away, thus affecting their accuracy, it is a comparatively simple matter to clip off the nuts on the inside with a hammer and cold chisel and put on a new pin or pin hole or both if necessary. The joints of he flasks are not planed. They are straight enough for all practical purposes just as they are cast. Each half of the mold is rammed on a matchplate which is absolutely accurate in its relation to the other half. For this reason the two sand faces of the mold will come together in their proper relation irrespective of whether the joints of the flask touch all around or not.

The depth of each flask is determined by the size of the casting which it is proposed to make in it and about two inches of sand are allowed over the highest point. All of the flasks are fitted up to take two patterns except the larger sizes which take only one each. The shortest castings are made four in a flask. Two cores are provided with a stop-off in the center of each. The castings are poured from a common gate which runs down the center of the patterns for their full length. This gate

FIG. 3—CUPOLAS AND MONORAIL SYSTEM FOR DISTRIBUTING THE IRON—THE CUPOLAS IN THIS SHOP ARE NEVER STOPPED UP DURING THE HEAT BUT RUN A STEADY STREAM OF IRON UNTIL THE BLAST IS TAKEN OFF

is connected to the molds on each side by a row of 1½-inch taps spaced 2 inches apart. This arrangement reduces the amount of lateral space required. It is possible to get 20 molds or 40 castings on each floor by economizing space in this manner. If the pipes were made one in a flask there would be room for only 30.

In addition to keeping the lateral space required down to a minimum, these flasks are provided with openings at each end through which the cores protrude. Under these circumstances it is necessary for the flasks to be only 2 inches longer than the patterns at each end; this 2 inches acts as core print. Both the copes and drags are provided with handles on the ends, consisting of short pieces of ¾-inch gas pipe which are cast in place when the flask is poured.

When the cores are in place and the flasks are closed, the lugs on the joint previously referred to are secured by an ingenious type of clamp. In ordinary practice the two adjoining flanges of a flask are held together during the pouring operation by either steel or iron clamps and iron or wooden wedges. In either case they are separate and distinct from each other, so it usually takes considerable time to hunt them up and more time to adjust and tighten them. The clamp used to hold the pipe flasks together at the Bingham & Taylor shop is a combination clamp and wedge. Imagine a flat cast-iron plate 3 inches square by ½ inch thick; on one side of the plate and cast integrally with it are two wedges on edge with the points of both wedges running in the same direction. All that is necessary to clamp a flask with this device is to tap it along until it becomes tight. This arrangement is the invention of James Gibney, superintendent of the Bingham & Taylor foundry, who is responsible for the many original devices and methods in use in this shop.

As may be seen at *A*, Fig. 1, these pipes are cast with a coarse screw thread of about 3-inch pitch. One pipe works inside the other and by this screw arrangement the complete pipe may be adjusted to any length. The cores for the sleeves, that is the pipes having internal threads, are made in a two-part iron core box. The box itself is made of iron but the parts forming the threads are of brass. They are detachable so that when they wear out they may be renewed. Since extreme lightness is aimed at in the finished casting, the outside surface conforms to the screw formation on the inside.

Therefore if the cores are not accurately made they will surely cut through. The two halves of the core box are assembled on a pair of horses and clamped together. The box is then stood up against a bench holding a supply of prepared sand with its lower end resting on a plate provided with an external guide for the box and an internal guide for the arbor. The arbor consists of a piece of wrought iron or steel pipe with numerous small holes all over its surface to proivde for the escape of the gas generated during the pouring process. Arbors of different sizes are used for the different sizes of pipes but the sand thickness in each case is about an inch. Thus in the smaller sizes which are only 3 inches in diameter the core arbor is 1 inch. This size is strong enough to resist the upward pressure of the fluid iron in the case of short castings, but in the longer lengths, 3 feet and upward, it has been found necessary to allow a chamber of 0.1-inch in the cores and molds. By adopting this precaution the castings come straight.

Considerable skill is required to ram the cores to the proper density. This is accomplished by feeding sand in a constant stream with one hand and ramming it with a wooden rammer about the size and shape of an ordinary lath with the other hand. When the core box is full the operator lifts it and places it horizontally on the horses previously referred to. After rapping it, he takes off the two clamps which hold it together and removes the top half of the box. Then he catches the exposed arbor at each end and, lifting it out of the box, carries it over and sets it in one of the molds. Each coremaker makes and sets the cores for two molders, working on the sleeve or outside casting.

The molds for the pipes and sleeves are made on stripping-plate machines built by the Bingham & Taylor company. Each pattern is attached to a pair of plungers which are in turn actuated by a single-acting arm controlled by a srort, straight lever. The general features of the machine may be seen in Fig. 1. Since the patterns are of half spherical cross section it is not necessary to drop them all the way to clear. In fact they are dropped only ¾-inch. The molds are all rammed by hand.

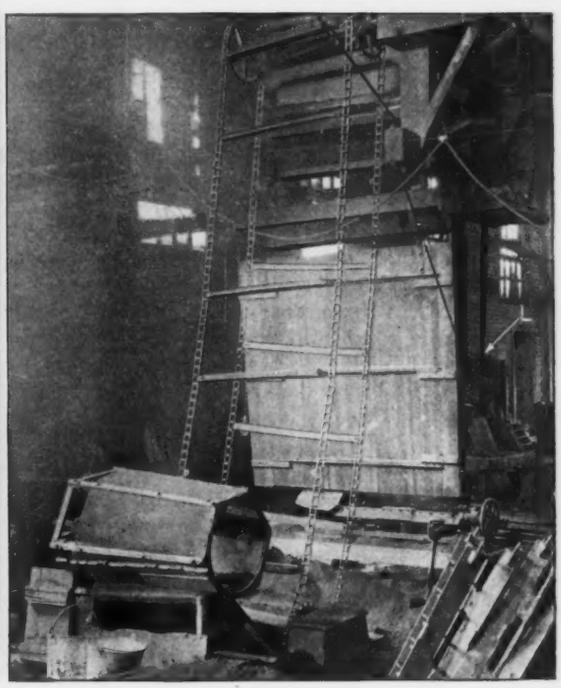

FIG. 4—MAIN BAY OF STEEL FOUNDRY WITH 3-TON HEROULT ELECTRIC STEEL FURNACE IN THE FOREGROUND. FIG. 5—GENERAL FEATURES OF APPARATUS FOR MAKING GREEN-SAND CORES FROM THREE FEET UP TO SIX FEET IN LENGTH

Each molder puts up about 40 flasks depending on the size of pipe and so efficient is the rigging that the loss does not average over 2 per cent.

The other piece of the pipe, that is the piece having the bell and flange on one end, which comes in direct contact with the valve or stop-cock when it is finally in position, is molded on the same type of machine as the sleeve and also in the same kind of a flask.

The cores for these pipes however are made in a radically different manner from the others. The pipes are threaded externally for a distance of 3 inches at one end and since it is not worth while building a thread on the core for such a short distance, it is made perfectly straight with the exception of the bell end.

The cores are made on the machine illustrated in Fig. 5. It may be described as an automatic gravity machine. All the coremaker has to do after preparing his sand is to place arbors in the machine and take the finished cores away. All the sand for the day is first put through the riddle shown in Fig. 5. After going through the riddle it is piled in a heap from which a bucket elevator carries it to the top of the machine. It drops from the buckets into another riddle which also acts as a distributor and falls down a wooden chute in a gentle spray onto the arbor.

The arbors are cast iron and are carefully machined at each end. The short ones are plain on the inside but the long ones are provided with four internal ribs extending longitudinally. This style of arbor is perfectly rigid and by its use chaplets are dispensed with in pipes up to six feet in length. An interesting feature in connection with these core arbors is the method employed in putting the vent holes in them. This is accomplished by sticking four rows of well tapered little chills at intervals of 1½ inches in the drag of the mold. The core holds them in place and after the castings are poured these chills are knocked in and removed to be used again. No vent holes are provided in the top side. When the arbor is in use of course the position is reversed.

The arbors are clay washed before being used and for this reason the sand for the cores is mixed considerably dryer than would be the case under ordinary circumstances. The sand thickness on the cores is only 3/8 inch and of course it absorbs nearly all the moisture off the arbor. This is one of the most ticklish features in connection with making these cores in green sand. The problem is to have the sand damp enough to hang to the arbor and still allow for future absorption of dampness from the arbor without having a core too wet to pour iron against.

Fig. 2 shows a close up of the device for holding the arbor while the sand is falling onto it. It is shown in position in Fig. 5. These machines are made in different lengths to correspond to the different lengths of pipe but the mechanism is the same in each case. The guide *A* Fig. 2 at the right hand end is stationary while the guide *B* at the other end is movable but is held in tension against the end of the arbor by a coil spring inside the collar, *C*, Fig. 5. The small end of the arbor is first placed in position and shoved hard up. This allows clearance at the stationary end to

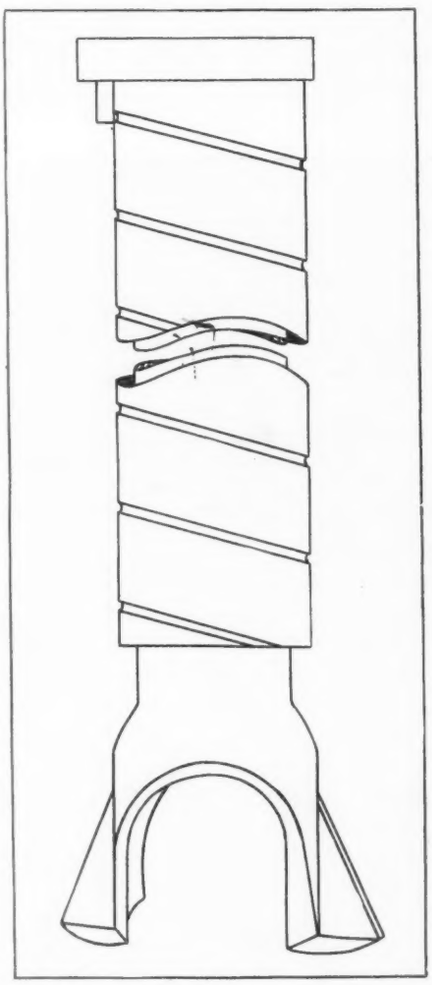

FIG 6—EXTENSION SHUT OFF BOX

slip the bell end of the arbor into place. When this is done the operator releases his pressure on the small end and the spring forces the arbor up tight against the other end. When the arbor is in place he pulls the lever *L*, Fig. 5, which starts the sand conveying apparatus. As the sand falls the man turns the hand wheel *H*, Fig. 2. This in turn revolves the arbor. The sand falls in a gentle stream and sticks to the arbor, the surplus being removed by the strike *S*, which has been previously adjusted to the proper diameter. About 20 turns of the wheel is required to form a core. Two men mix the sand, prepare the arbors, and make and set 400 cores a day.

The speed at which the machine is driven has an important bearing on the success or failure of the cores when they are surrounded by the molten iron. If the sand is too hard the tops of the castings will be nothing but shells and if too soft the castings will be over weight besides running the risk of having the iron break in through the vent holes. The machine is driven electrically. The main shaft is provided with a loose and tight pulley with a clutch arrangement for throwing it in and out of gear. It is controlled by the lever *L*, Fig. 5.

The melting equipment consists of three cupolas 60, 72 and 102 inches respectively in diameter inside of lining. They are so arranged that they may be operated together or separately. J. W. Gibney, the foundry superintendent who, as previously stated, is responsible for the labor saving devices in this shop, has also developed some ideas on cupola practice. For instance, the blast for all three cupolas is furnished by a single 28-inch fan of the centrifugal type. When it is remembered that this is the size of fan usually recommended for 36-inch furnaces, the significance of its performance will be appreciated. The three cupolas are never all used at the same time, but the fan will supply air for either the largest or for the other two.

The iron is distributed in 1000-pound ladles which hang from a monorail system extending to all parts of the shop. The stream from the cupola is never stopped during a heat; the shanks on the ladles are detachable, thus permitting each one to hug the preceding one closely. As fast as one ladle is filled it is pulled away and the next one goes under the spout after the fashion of stove molders "catching in."

A general view of the Bingham & Taylor steel foundry with a 3-ton heroult electric steel foundry in the foreground is shown in Fig. 4. The steel is tapped into a tea-kettle ladle which has the advantage of bottom pouring without the trouble incidental to the use of stoppers. From this ladle the steel is distributed in double-shank ladles holding about 150 pounds each, which are used to pour off the small work, the heavier pieces of course being poured direct from the crane ladle. Most of the work is poured in green-sand molds. Some of the heavier molds are skin dried and nailed all over their faces. The molds are skin dried in various ways, with gasoline hand torches, with gas burners and with charcoal fires, all depending of course on the depth of drying required.

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C. K. Thomas & Co., consulting engineering firm which recently removed to new quarters at 10 Bridge street, New York, has inaugurated an export department which will represent exporters in purchasing, inspecting, etc.

# Pointers on Molding Car Couplers

## Special Arrangements for Handling the Molds Are Desirable—Lifting Trucks Can be Used to Advantage—How Molding Machines Are Rigged—Special System for Handling Molds

LIKE the chunks of birchwood in the mountaineer's big open fireplace, which burns night and day the year around, there are certain classes of orders which can be depended on to feed the flames of industry in war or in peace, in times of prosperity or periods of depression. They are the backlogs of business. Prominent in this category, in the steel castings trade, are railroad car couplers. As long as trains are run draft gears will come to grief, and even when few cars are being built, the demand for couplers for replacement purposes is sufficient to absorb a large amount of steel foundry effort. In times like the present, when large numbers of cars also are under construction, a huge tonnage is required for couplers. Although couplers are ordinary castings they must withstand extraordinary abuse, and quality, therefore, must be the first consideration in their manufacture. They are made today in so many shops and in such huge quantities that many different methods of molding and casting them have been developed—all more or less successful. In spite of this situation, the subject of coupler production is by no means exhausted and when the United States railroad administration last year designed a new standardized coupler, many foundrymen found themselves again confronted with an old familiar problem in a new guise.

Success in the manufacture of freight car couplers, from the standpoint of economical production, hinges on the facilities available and methods adopted for handling the finished molds and cores and the raw materials from which they are made. The problem revolves largely around the question of efficient shop transportation.

The standard United States railroad administration coupler, rough as it comes from the sand, is shown in Fig. 2. In general it is similar to an ordinary steel coupler casting. To insure sound metal, four large shrink heads are provided, one on each corner of the casting, which is poured in an upright position. The runner and pouring gate are attached to the nose of the casting, the gate being fixed to the lower flange. The jaws are formed by a large dry-sand core which may consist of two parts pasted together as shown in Fig. 3. As cast, the coupler weighs 190 to 200 pounds, its finished weight being 185 pounds. The percentage of remelt, therefore, is low.

The core is approximately 8 inches square and 15 inches in length. It may be made in several different ways. One satisfactory way, if molding machines are not available, is to make it in a metal core box of the booking type, ramming it by hand on a bench. The output by this method should approximate 75 to 100 cores per day per man. The job is a little too heavy for a woman. The work may be considerably lightened and the production increased to approximately 110 cores per day by installing a small plain jolt-ramming machine. Another and perhaps more satisfactory method of making these cores is to turn them out in halves, which are later pasted together, using small rock-over core molding machines. An 8 x 14-inch machine is sufficiently large and a wooden core box such as that shown in Fig. 9 may be employed. If more permanent equipment is de-

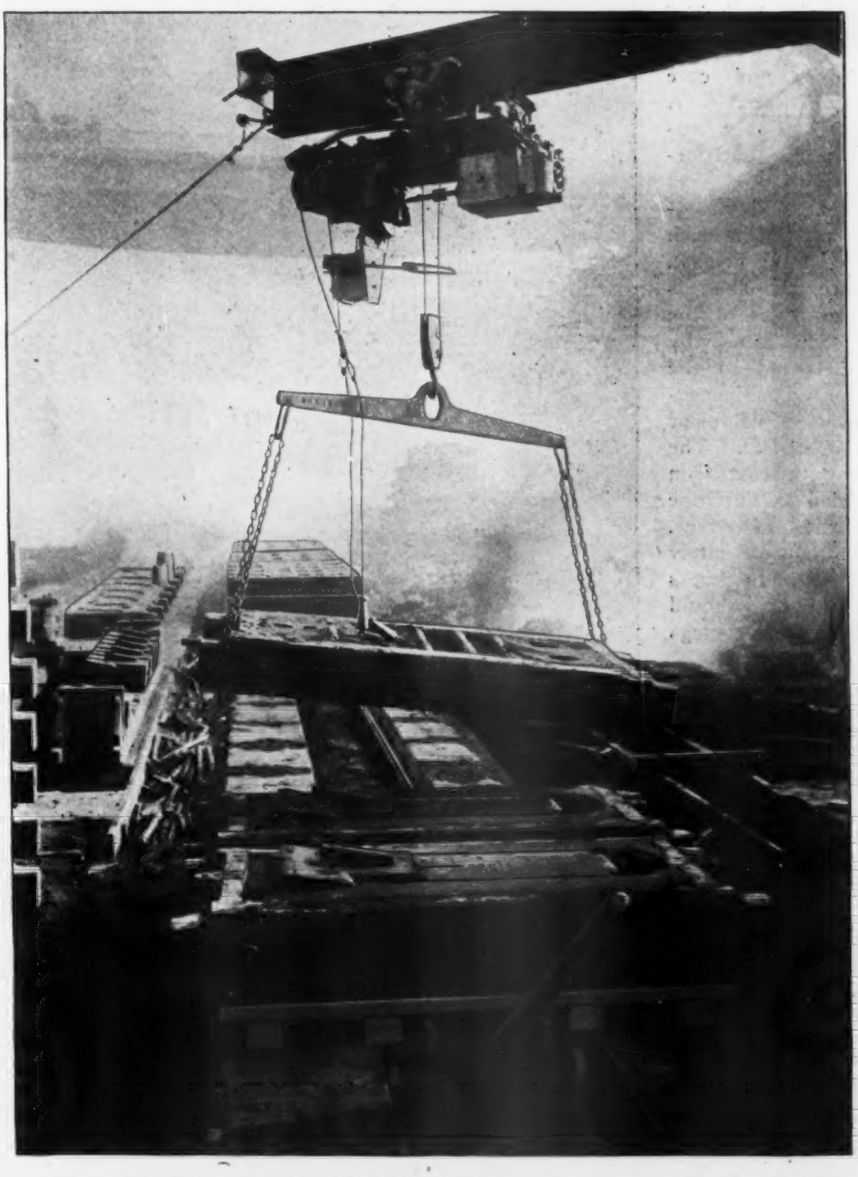


FIG. 1—FREIGHT-CAR COUPLERS MUST BE PRODUCED ON A QUANTITY PRODUCTION BASIS—JIB CRANES FOR CLOSING MOLDS AND SPECIAL RUNWAYS FOR HANDLING FLASKS SPEED-UP THE JOB

FIG. 2—STANDARD COUPLER CASTINGS WITH RISERS AND GATES ATTACHED

sired, metal core boxes and core patterns may be substituted. A counter-balanced, hand roll-over machine of standard type is satisfactory.

A couple of twisted bars about ¼-inch in diameter are placed in each half of the core to strengthen it. When making the core, the sand is first peened around the edges of the core box which is then jolted by means of the lever attached to the machine. Finally the sand is butted-off, the rods being inserted just prior to the butt-ramming operation. The cores are rolled out onto cast iron plates and may be dried in any one of several different types of ovens. The plates should be approximately 10 x 16 inches and ¼-inch in thickness to prevent warping. They also should be provided with ribs or short legs on the under side. Since the cores are made in halves by this method, if large production is sought, at least two machines will be necessary. The half cores should be produced at prices varying from 3½ to 4¼ cents each. The production of each machine should be from 150 to 170 half cores per day.

Various types of core ovens which may be used on this job are suggested by Figs. 4 and 9. Other kinds of ovens, especially those of the stationary or swinging shelf types, also may be employed. Fig. 4 shows a car-type oven of standard construction. In this case the cores are placed in a rack which is set on the platform of the car by means of a crane. This arrangement, while satisfactory, is more or less of a makeshift; its principal advantage lies in the fact that practically no special equipment is required. It is most suitable for a foundry turning out only a limited number of couplers.

FIG. 4—ORDINARY CAR TYPE OVENS MAY BE USED FOR DRYING THE CORES

FIG. 3—THE CORES, AFTER BEING PASTED TOGETHER, SHOULD BE PLACED IN RACKS FOR

Better results can be obtained by using a rack similar to that shown in Fig. 5, the cores in this case being shifted into and out of the oven by means of a lifting truck. If a double-ended oven is located between the core room and the molding floor, this arrangement is exceedingly satisfactory, since it permits of continuous baking and the lifting truck makes it possible to handle the racks with a minimum of effort. On the delivery side of the oven, the racks may be picked up by a crane and transferred bodily to the point where the cores are set in the molds, or, if split cores

are used, they must first be pasted together and then transferred to the molding floors on special carriers handled by the crane, by an overhead trolley, or by other means. A method of adapting a storage battery truck to this purpose is illustrated in Fig. 6. Such a truck not only handles the cores economically and without breakage, but it also may be used for numerous other purposes throughout the shop. Since the cores are rather bulky, they should be baked at a fairly high temperature, from 450 to 550 degrees. Two hours should be sufficient.

A more highly developed method of baking the cores is by means of a continuous oven such as that illustrated in Fig. 9. This oven, which is not unlike that employed by the Crane Co. in its old malleable pipe-

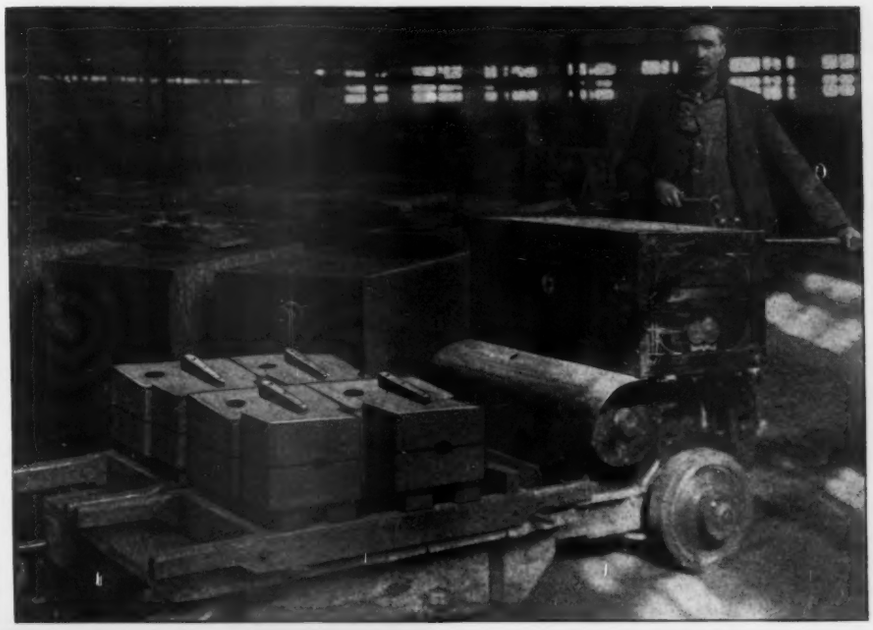


FIG. 6—FINISHED CORES IN A RACK MAY BE TRANSFERED BY BATTERY TRUCK

FIG. 5 — STEEL FRAME RACK AND LIFTING TRUCK FORM A COMBINATION

fitting shop in Chicago, is arranged to burn either fuel oil, natural gas or artificial gas. Gas is perhaps the most satisfactory fuel, if it can be obtained economically. The oven consists simply of a rectangular chamber approximately 3½ feet square and 18 feet long, suitably lined with brick. The burner consists of a 2-inch perforated pipe which extends the full length of the oven along the floor. Two rows of holes are bored in the burner pipe at angles of 45 degrees from the vertical plane. The flame is deflected by means of a sheet steel shield about 6 inches wide which extends over the pipe. The cores are carried through the oven on the motor-operated endless conveyor shown in Fig. 9. This conveyor may be arranged to move continuously or intermittently. In the former case the speed must be adjusted to the time of drying and arrangements secured for the steady production of cores without interruption. The small motor shown on top of the oven drives the blast fan which feeds air to the burner pipe. If oil fuel is used, it may be atomized by steam or air. If the latter is employed it may easily be preheated by passing it through a coil located in one side of the oven.

Couplers are molded almost invariably in two part flasks approximately 52 inches long and 18 inches wide, with 10-inch drags and 8-inch copes. The flasks may be built of wood, although on account of the hard usage they receive, cast iron or steel boxes are preferred.

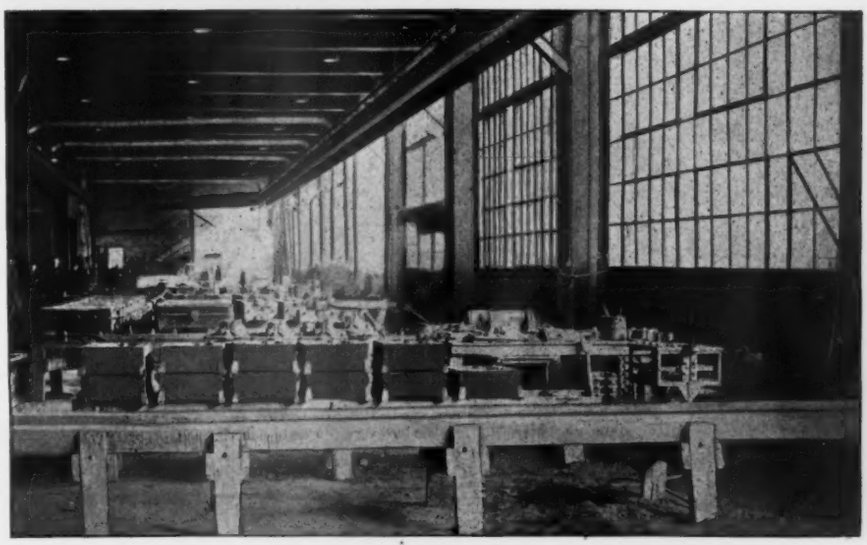


FIG. 7—THE MOLDS MAY BE SET ON SPECIAL HORSES FOR POURING

Various methods of molding may be employed. If the order includes only a few couplers, the flasks may be rammed up on the floor using ordinary bottom boards and pneumatic rammers. In any event, it is preferable to fasten the pattern, which may be either wood or metal, to a permanent bottom board fitted with flask pins, on which the drags may be rammed.

The next step in advance of hand-ramming is to employ a plain jolt machine for ramming the copes and drags. Some foundrymen believe that on account of the bars in the copes they cannot be jolted successfully. This conception, however, is erroneous and there is no reason why the copes cannot be jolt-rammed as well as the drags. If the order is large it probably would pay to buy a special machine for this purpose.

The most successful method of molding the drags, however, is to employ a combination jolt-ram, turn-over, pattern-drawing machine similar to that illustrated in Fig. 11. This machine was built by the International Molding Machine Co., Chicago, for general foundry purposes and adapted to the production of railroad couplers in the manner illustrated. The adaptation is confined to the manner in which the pattern is fastened to the machine and to the arrangement of the receiving table on the pattern-drawing side of the machine.

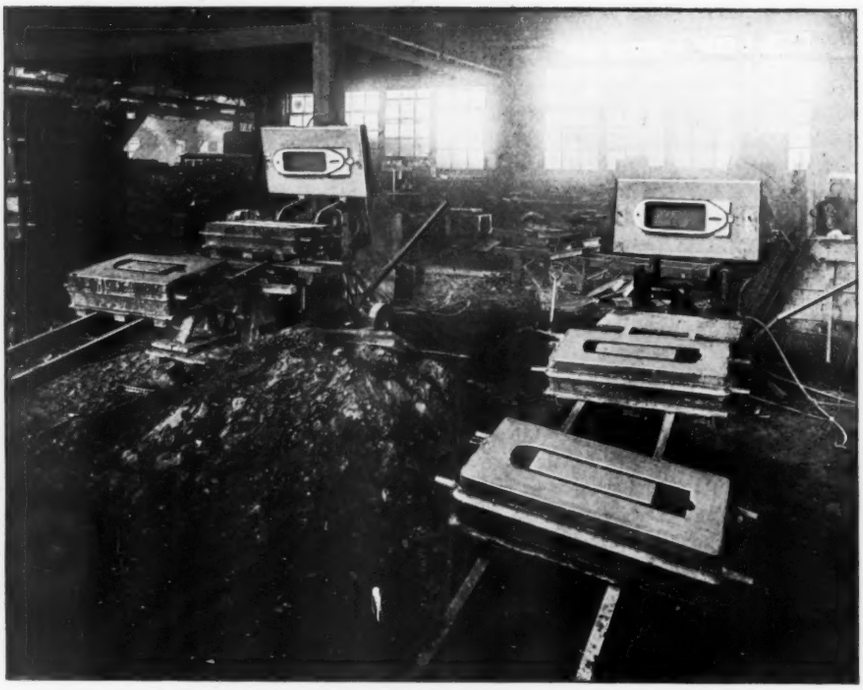


FIG. 8—INCLINED SKIDS ARE CONVENIENT FOR TRANSFERRING MOLDS BETWEEN THE MACHINES AND THE FLOOR

Four small pneumatically-operated lugs which are fixed to the corners of the receiving table automatically level the flask for drawing the pattern. The frame of the receiving table is so constructed that a car for carrying away the mold can be run under the flask after the pattern is drawn, the table and flask being elevated for this purpose by means of a pneumatic cylinder.

In the installation illustrated in Fig. 11, the sand is delivered to the molding floor in drop-bottom buckets by means of a traveling crane. This sand comes to the molders in a fully prepared condition. It is dumped out on the floor from which it is shoveled

FIG. 9—AN OIL OR GAS BURNING CONTINUOUS CORE OVEN MAY BE EMPLOYED TOGETHER WITH CORE-MOLDING MACHINES FOR MAKING THE CORES

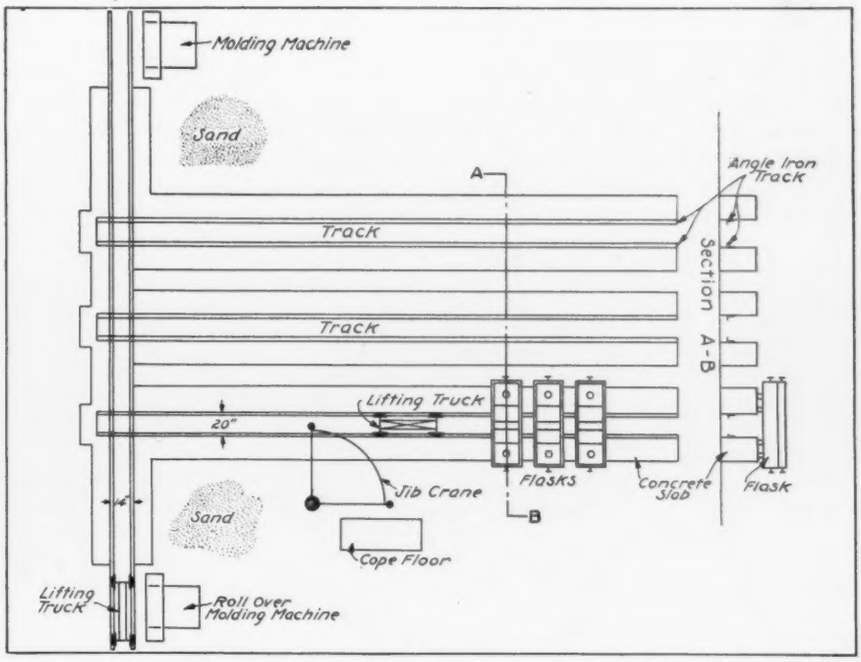



FIG. 10—PLAN OF FLOOR SHOWING ARRANGEMENT OF TRACKS AND RUNWAYS FOR HANDLING SMALL CASTINGS IN A STEEL FOUNDRY

into the flasks as the molds are made. Owing to the fact that this job is particularly well adapted to quantity production, this method of handling the sand can be improved upon by the installation of overhead bins from which the sand flows by gravity into the flasks. These bins, of course, must be provided with a suitable elevating mechanism for handling the incoming sand and dumping it into the bin.

If a jar-ram roll-over pattern-drawing machine is employed, two helpers and a machine operator should turn out from 130 to 150 molds per day. If the copes are rammed on the floor by hand on cope boards four additional men will be needed, one molder and a helper being assigned to each cope board. Two cope board outfits are necessary to supply one molding machine. If the copes are machine-rammed, two outfits should be able to keep up with three drag molding machines. In addition, one man is necessary for setting the cores and closing the molds for each machine floor.

One of the chief problems encountered in executing this job centers around handling the flasks between the molding floors and point of pouring. If enough production is to be obtained from each floor to meet the severely competitive conditions found in the coupler field, the stream of production must be steady and uninterrupted. This means that special arrangements should be made for handling the flasks. It will not do simply to reserve a certain amount of floor area on which they can be set out by the machine operators in the ordinary manner. One suitable plan would be to provide a fast light electric crane and employ a couple of extra men exclusively for handling flasks and closing molds.

In most shops, more elaborate arrangements will be found both advisable and economical. If the shop floor is satisfactory, the molds can be handled by means of a heavy-duty storage-battery lifting truck of the type illustrated in Fig. 6. The molds also may be skidded away from the machines on inclined rails as shown in Fig. 8. When they reach the bot-

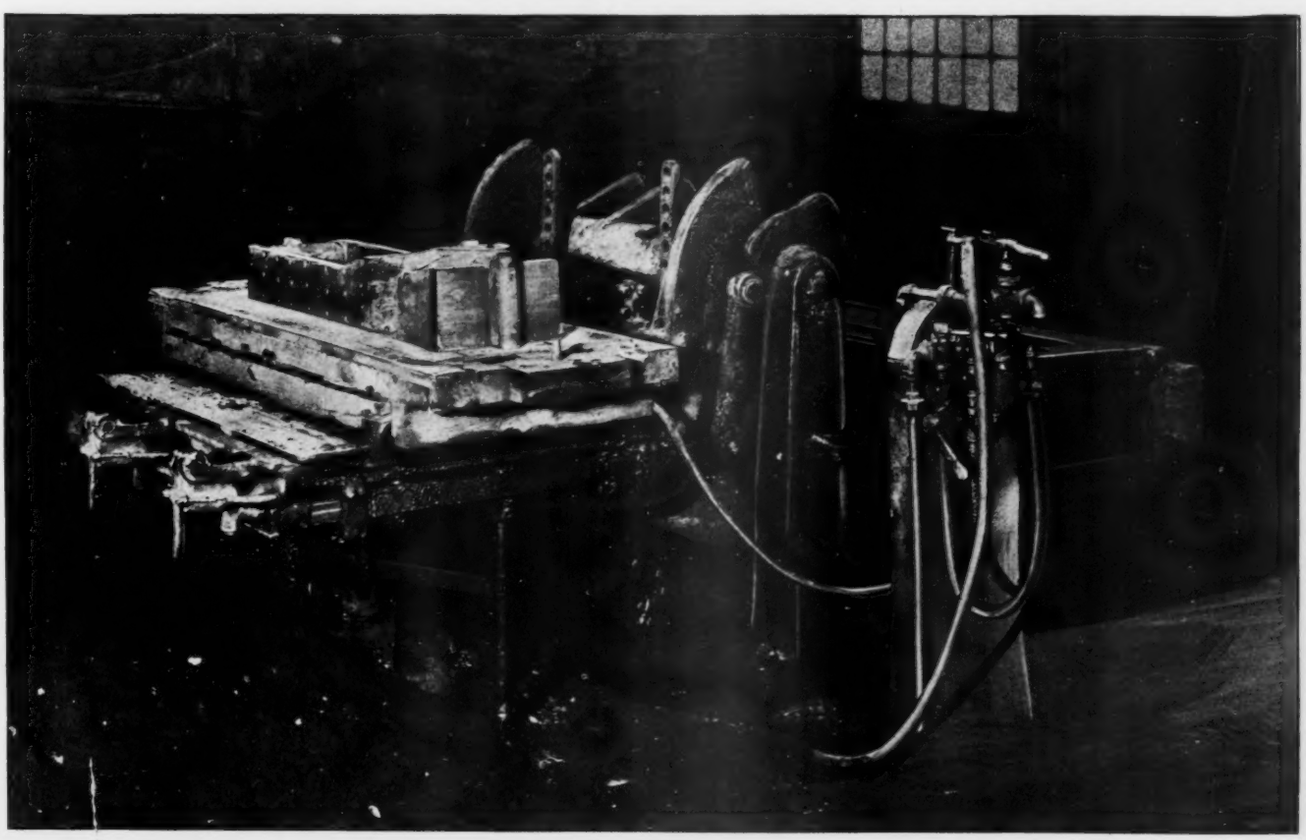


FIG. 11—JAR-RAM TURN-OVER DRAW MOLDING MACHINE USED FOR THE PRODUCTION OF COUPLER CASTINGS

tom of the incline they are picked up by a crane and set down in the proper position on the floor for pouring. A gravity type roller conveyor, similar to that employed by the Cadillac Motor Car Co., for handling molds in its cylinder foundry, also could be utilized. If the day's output is relatively small, the molds could be picked up by a crane and set out on horses for pouring. This method of handling the job is illustrated in Fig. 7 which shows a view in a foundry in Michigan.

Some sort of a track arrangement also may be worked out. It may be operated either with or without lifting trucks. If the shop floor is satisfactory, lifting trucks may be employed without tracks. In this case special bottom boards should be designed with blocks underneath sufficiently large to permit of the withdrawal of the platform of the elevating truck after it has set the mold on the floor. The molds should be arranged in perfectly straight rows in order to facilitate pouring. If a traveling crane is available, and this job hardly can be handled without one, the rows should be parallel to the crane runway. This is preferable to having them extend across the shop since the crane bridge can be controlled more readily than the trolley when a ladleful of molten metal is suspended underneath.

A rather novel track arrangement for laying out coupler molds for pouring is shown in Figs. 1 and 10, the latter being a plan of a section of the shop. This installation, which is rather expensive, consists of a series of concrete runways extending parallel to the main axis of the shop. Each runway is formed by two concrete slabs approximately two feet square and of any convenient length. They are set on 4-foot centers being separated by spaces 20 inches wide. Down these aisles or runways the lifting trucks which handle the molds are operated. These trucks run on angle-iron tracks which are bolted to the concrete as shown in Figs. 1 and 10. These concrete runways form an even, level support for the molds during the process of setting cores, closing and pouring.

A transfer track extends across one end of the group of runways, as shown in Fig. 10, molding machines being located at either end of the track. The molds are handled entirely by lifting trucks. The cope floor is located along one side of the runway, the copes being set on the molds by an electric jib crane. This operation is clearly illustrated in Fig. 1. It is almost equally feasible to handle the copes by hand. A floor such as that shown in Fig. 10, with three runways 150 feet long, should have a capacity of 225 molds.

The molds are poured through a bottom-pour gate which extends down behind the core. Four risers are attached to each casting, as previously described. The risers are 2 x 3 inches in cross-section.

When ready for shaking-out, the molds are picked up by a traveling crane or by some other conveyor and transferred to the shaking-out floor. At this point the rough castings are gathered into groups for transportation to the cleaning room, while the sand is cut over and prepared for redistribution to the molding room.

The risers are notched where they join the castings and, therefore, may be readily broken off with a quick blow from a sledge. The core is removed by flogging the castings. Fins and other irregularities are removed by chipping with an air hammer in the ordinary manner.

After this preliminary cleaning the castings are annealed, not heat treated, simply to relieve cooling strains. For final cleaning they may either be tumbled in heavy mills or sand-blasted. Most shops turning out couplers lean toward the sand-blasting method, partly on account of the superior finish obtained. After cleaning, if the castings pass the prescribed tests, they are ready for shipment.

## Cope Core Prints

*By M. E. Duggan*

Cope core-prints are a bone of contention between the pattern shop and the foundry. When to use them, what sizes are required for different cored openings, what is the greatest core length that may be secured in place either vertically or horizontally without the use of prints, are questions to which widely varied answers are returned. Core print data offer widely divergent information on the subject and the practical examination of patterns reflects varying ideas on the subject.

The writer recently had occasion to examine three patterns made by different concerns for the same class of work in a large jobbing foundry. These patterns showed that there is no existing standard for cope core prints. The thickness of stock at the cored holes, the diameter of the cored holes, number of holes, length of drag prints and cope prints are given as follows:

| Thickness of pattern, | No. of | Diameter of holes, | Length of drag point, | Length of cope point, |
|---|---|---|---|---|
| inches | holes | inches, | inches | inches |
| 2 | 2 | 1 | 2 | 1¼ |
| 2½ | 3 | 1⅛ | 1⅛ | 1⅛ |
| 6 | 7 | 1⅞ | ½ | ⅝ |

It may be noted that the pattern, thin in section, was provided with core prints which would be considered more than twice the length required as compared with the pattern, which was 6 inches thick.

The question is not whether the mold can be made successfully and a casting produced from a pattern fitted with core prints varying from ½-inch to 1½ inches or 2½ inches long, the molder usually can adapt his work to the pattern supplied, the inconsistency lies in putting a 1¼-inch cope print and 2-inch drag print on a 2-inch core, when ⅝-inch and ½-inch prints respectively, would be satisfactory.

The difficulty, at times may be assigned to the molder's conception of what is needed. Two years ago the writer made a pattern for a large plate casting; seven vertically-cored holes were provided, two of them square and five round, with the metal at the holes 2, 4½ and 10 inches thick at the cored holes. The pattern as produced carried both drag and cope prints, the square prints fastened to the pattern and the round cope prints loosely fixed to the surface. A set of castings was made and the pattern was returned to the storage loft. Later, when another set of castings was needed from the same pattern, new cope prints had to be made as those originally provided could not be found. Recently another repeat order developed the fact that again the prints were missing. Inquiry showed that the molders intentionally had removed the prints, considering that any vertical core was secure in the the mold without cope prints up to a 2-inch core, 36 inches long.

If cope prints *are* unnecessary under certain limits, these limits should be established and set forth for the information of the paternmaker, as much valuable time thereby will be saved.

## Purchase Propeller Plant

The George H. Thatcher Co., founders, Albany, N. Y., has purchased the American Screw Propeller Co., engineers and designers, Philadelphia, and will bring this organization to Albany to act as their engineering and designing department on screw propellers and other marine work. The name of the George H. Thatcher Co. has been changed to the Thatcher Propeller & Foundry Corp.

The Bronzo Alumina Corp., Buffalo, manufacturers of die castings as well as sand castings in brass, bronze and aluminum, has removed its plant from Tonawanda, N. Y., to Buffalo, where it is located at 212-218 Winchester avenue.

# Hoosier Foundry Seeks Difficulties

## Extensive Study of the Purposes for Which a Casting is Intended and the Properties Desired in the Part is Made Before Production is Attempted in This Steel Foundry

By D. M. AVEY

FEW foundrymen seek trouble. In fact the average producer of castings is content to wait until difficulty stares him in the face. Then, if he is reasonably energetic, he grapples with the problem, and not infrequently concentrates the energies of the entire shop organization on its solution. But in most plants, seeking troubles before they appear is looked upon as a needless waste of time and effort. In a certain steel foundry in Indianapolis which handles a variety of light and medium work, this condition is reversed. This foundry, operated by the Electric Steel Co. of Indiana, literally hunts for trouble, and by meeting it more than half way overcomes it in its incipiency.

FIG. 1—A TYPICAL CASE WHICH WAS THOROUGHLY DIAGNOSED BEFORE AN ATTEMPT WAS MADE AT MOLDING AND CASTING

FIG. 2 — MICROGRAPH OF THE COUPLING-BOX CASTING WHICH FAILED — SPECIMEN WAS ETCHED WITH 2 PER CENT NITRIC ACID IN ALCOHOL AND MAGNIFIED 60 DIAMETERS

Any new job offering special difficulties in any of the processes of molding, casting or annealing is met with a spirit of real pleasure. Metallurgical troubles especially are welcomed, as are new problems capable of solution with the aid of chemical reagents and the micro-camera.

Fig. 1 shows a typical "case" brought to this plant and solved with satisfaction to the customer and apparently greater pleasure to the management. The illustration shows two views of a rolling mill coupling box or as it is sometimes called a *wabbler* or *crab*. This coupling casting may vary in size from a few inches up to more than two feet in diameter. It slips over the end of the roll spindle and forms a connection with the driving pinion by which the roll is turned. The coupling box is designed to drive the mill, to take tremendous stresses when the rolls are reversed, and further to act as a safeguard and break at a lower stress than the roll spindle. This nice point of design in a coupling-box is difficult to attain. It must be strong enough and yet not too strong.

### *Answering the Query—Why?*

A certain steel mill had difficulty with its coupling-boxes. At times the casting would last several weeks, but more often a few days constituted the life of this part. The job of making some of these coupling-boxes was offered the foundry which welcomed trouble. The search for the difficulty was started with a casting which had failed, and one of them was obtained at once by the Indianapolis foundry for inspection and test. No glaring structural defects which would indicate faulty molding or casting were apparent. The break was more in the nature of a tear where the torsion of the spindle was resisted by the metal section of the coupling-box. This offered a clue.

A test section was cut out from the broken part. This was submitted for analysis, physical test and micro-inspection. The analysis showed carbon, 0.39 per cent; silicon, 0.22 per cent; manganese, 0.63 per cent; phosphorus, 0.021 per cent; and sulphur, 0.045 per cent. It was thought that the carbon was too high, and probably for this reason the casting was not sufficiently ductile under changing stresses. This theory was upheld by the physical tests which are presented in Table I accompanying. It will be noted, although the elastic limit is 47,850 pounds per square inch and the ultimate strain is 76,300 pounds per square inch, that the elongation is only 7.0 and the reduction of area only 6.8 per cent. The micrograph which is reproduced in Fig. 2 shows a coarse grained structure which to the management of the foundry indicated a faulty anneal. The knowledge contributed through this thorough analysis gave a starting point and definite objective. It was decided that a lower carbon steel was desirable for ductility and that a thorough annealing would give a better structure. The new coupling-boxes were molded and a metal of the following analysis was used in pouring them: Carbon, 0.22 per cent; silicon, 0.245 per cent; manganese, 0.640 per cent; phosphorus, 0.034 per cent; and sulphur,

FIG. 3—MICROGRAPH OF SPECIMEN FROM THE NEW COUPLING-BOX METAL — TEST PIECE WAS ANNEALED WITH THE CASTINGS AND GIVEN THE SAME ETCHING AND MAGNIFICATION

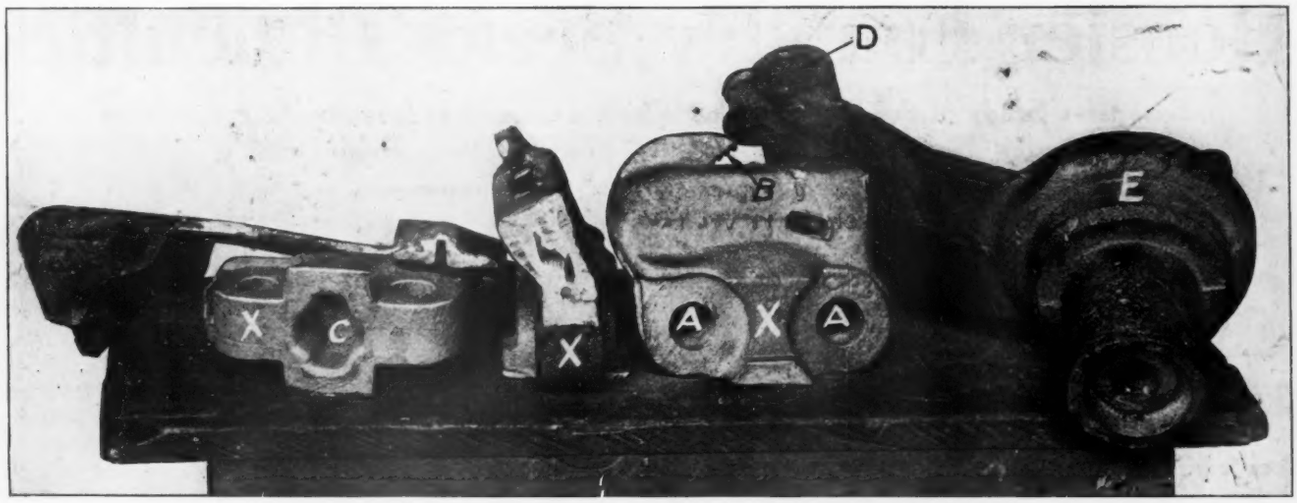



FIG. 4—TYPICAL SMALL CASTINGS MADE IN THIS FOUNDRY FROM ELECTRIC FURNACE STEEL

0.032 per cent. The physical properties demonstrated by an annealed test section similar in size to that used to represent the broken casting showed both elastic limit and ultimate strength slightly lower than before. The material in the new castings developed 38,100 and 73,100 pounds per square inch for the elastic limit and ultimate strength respectively. However, the percentage of elongation shown in the new metal was 21.0 and the reduction in area was 30.9 per cent. Ductility and resilience under repeated and reversing stress were attained, and without the sacrifice of a yield point which would permit the coupling box to fracture before the spindle failed. The micrograph, Fig. 3, shows the grain structure of the new castings. These coupling boxes have been in service continuously for about five months, and have vindicated the policy of "troubling trouble before trouble troubles you."

The diversity of the work handled by the Electric Steel Co. of Indiana presents many interesting points in molding, casting and finishing castings. Each job which enters the shop forms the basis for thorough investigation before actual production is started. Experimental castings are made, tested, sawed apart and thoroughly studied. The service to which each part is destined directs the course of the investigation

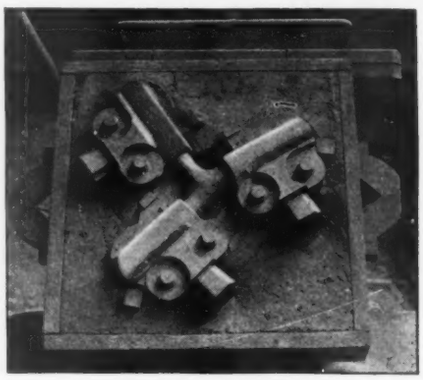


FIG. 5—SAND MATCH AND PATTERNS FOR COAL CUTTER CASTINGS

and every care is exercised to build up the physical properties desired.

Diagnosis is the first step toward performing a cure of any ill. The Electric Steel Co. has devised a simple but comprehensive system for performing a general diagnosis of its casting ailments. The accompanying Table II shows the system that is used. This chart contains a list of the various causes that produce failures in the castings. Opposite these are spaces representing each day of the month and a column for the total and percentage of defectives due to each cause. As may be noted, this gives an immediate check upon the most general ailments and steps then may be taken to rectify molding and casting errors.

A number of representative castings are shown in Fig. 4. Complicated form and section characterize the crooked little casting shown in the three views *X*. A quantity of these castings are made on intermittent orders furnished by a large manufacturer of mining and conveying machinery. The casting shown is a holder for a tool used in cutting through a bed of coal. A cutting tool is wedged into the notched jaw shown at *B*. The tool holder casting then is linked into an endless chain with a number of other similar cutters, and as the cutting machine is moved forward, the successive cutters drag across the coal surface and cut a groove with an action similar to the teeth in a

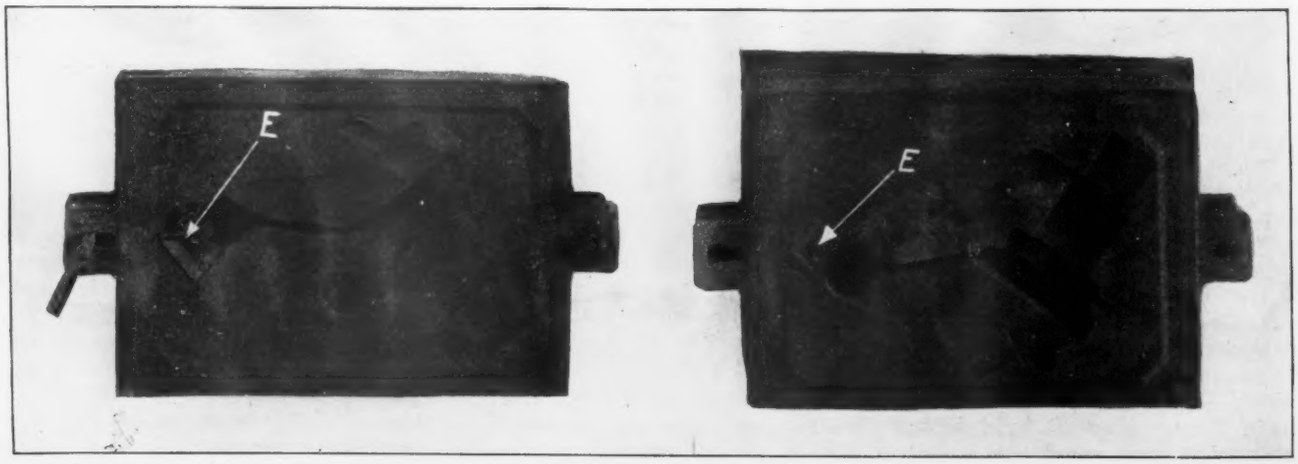



FIG. 6—MOLD FOR A TIRE-HOLDER CASTING MADE FROM MATCH PLATES

FIG. 7—ANNEALING OVEN WHERE SMALL AND MEDIUM CASTINGS ARE TREATED

band saw. The cutter castings are made from seven different patterns, similar except for the angle between the portion which holds the cutting tool and the base portion which is linked through the pin holes *A* to the endless chain. This angle may be noted in the end view of the cutter casting in Fig. 4. The seven different castings are set into the endless chain in such a manner that each succeeding cutter widens the cut until the seventh will leave an opening wide enough for the entire cutting chain to enter.

Molding rather than metallurgical problems are encountered in the manufacture of this casting. It was decided to use a sand match as comparatively few are needed at one time and repeat orders bring the job into the shop only at intervals. The inexpensive rig used is shown in Fig. 5. The patterns are set in a sand match with a set gate. The drag is rammed in a snap flask, rolled over and the match is drawn leaving the patterns in place in the drag. The cope flask then is set, rammed and removed, the patterns are drawn from the drag and the cores are set. Five small cores are used. One which carries a chill forms the recess in the base at *C;* a single long core forms the opening in which the cutting tool afterward is set; two round cores form the holes for the connecting-link pins and a single small core makes the hole in the side of the casting as shown in *D*. The prints for all these cores are shown on the patterns in Fig. 5.

Another interesting casting which forms a continuous job for this foundry is that shown at *E*, Fig. 4. This is a mounting to carry a spare wheel and tire for a passenger car built in Indianapolis. The part formerly was made from malleable iron, but last year steel was chosen for this part and an extra strengthening web was added to give additional rigidity. This job is molded from two match plates. The completed cope and drag are shown in Fig. 6. It will be noted that in addition to using flask pins for locating the two halves of the mold, male and female guides are provided on the match plates. The prints of these may be seen in the molds. The hub is cored out, as is also the bolt hole shown at *D*, Fig. 4. Two small bosses at the back of this part are formed by the small cores set in the mold as shown at *E*, Fig. 6. The mold is gated midway in the angle formed by the casting and runners are carried to the two extremities. A single riser is used at the lower extremity of the casting. The difficulty incident to this job was mainly due to the two thin-web sections set at right angles to each other, and joined to a heavier portion at the two ends. The method of

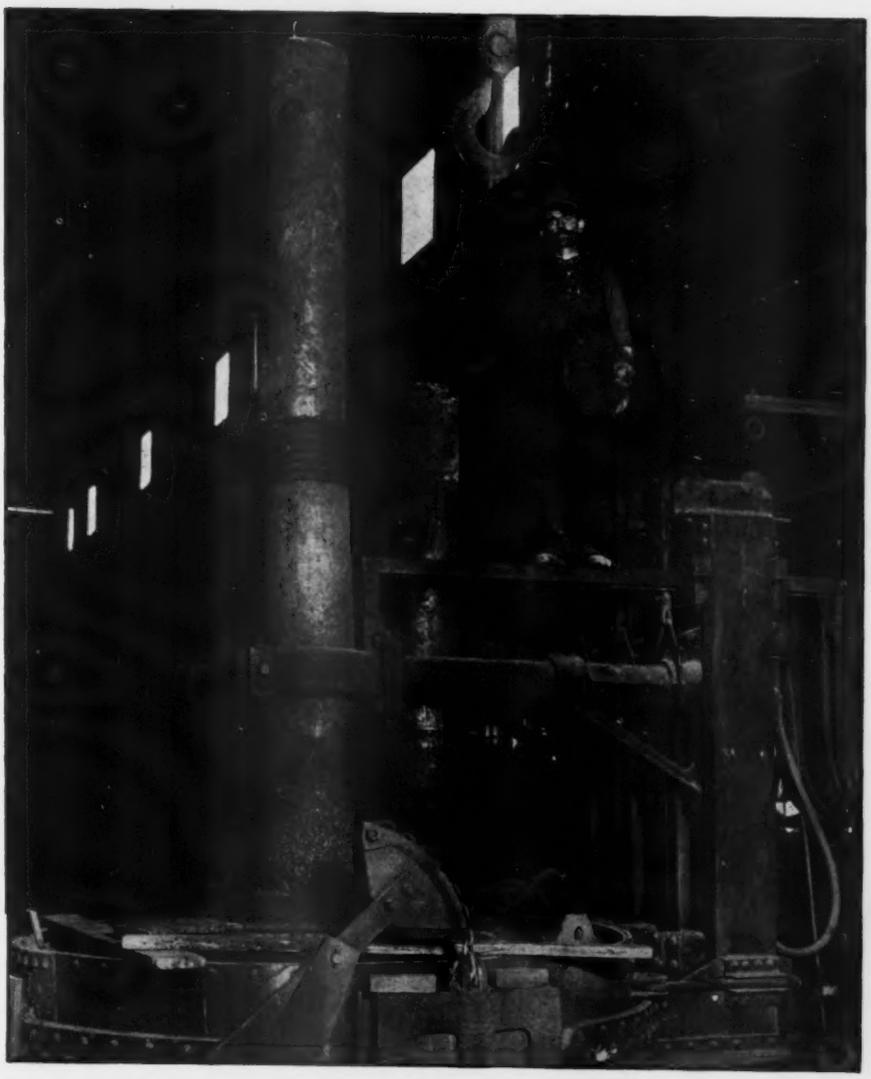


FIG. 8—BUSINESS END OF THE THREE-TON ELECTRIC FURNACE—NOTE THE SCREW DOWEL FOR CONNECTING NEW CARBON TO THE OLD ONE

## Table I

### Physical Tests of Steel for Old and New Boxes

| Specimen | Area in sq. in. | Elas. limit in lbs. | Elas. limit per sq. in. in lbs. | Ult. strain in lbs. | Ult. strain per sq. in. in lbs. | Elong. Per Cent in Length | Area of Reduc. Sec. in Inch. | Reduc. of Area | Per Cent of Reduc. |
|---|---|---|---|---|---|---|---|---|---|
| Old | 0.2006 | 9560 | 47850 | 15280 | 76300 | 7.0 | 0.1870D | 0.0136 | 6 8 |
| New | 0.2003 | 7680 | 38400 | 14220 | 71100 | 22.0 | 0.1359 | 0.0644 | 32.0 |

gating and pouring chosen has resulted in clean sound castings.

Proper pouring and correct gating are phases of the foundry problem which receive much attention at this plant. Occasions are mentioned where a new job has been gated in several different ways and the resultant castings have been sawed in different sections to hunt for hidden defects. Slag inclusions are guarded against at every point in the operations. The large *teapot* type ladle shown in Fig. 9 is used to receive the metal from the electric furnace. In this ladle, the metal enters at the bottom of the portion which corresponds to the teapot spout, and rising to the edge, flows over the lip. This prevents slag from overflowing from the molten surface, and gives the advantages of bottom pouring without the pressure and washing effect which is sometimes experienced with the bottom pour ladle. The medium and light castings are poured from bull ladles and shanks filled from the crane ladle.

Steel for all classes of castings made by this company is furnished from a 3-ton acid lined Heroult furnace. Current from the Indianapolis city power mains is delivered 4300 volts and stepped down to 90 to 110 volts for use in the plant. Five heats are made every 24 hours. Three 14-inch carbon electrodes are used. These are operated and controlled by an automatic device manufactured by the General Electric Co., Schenectady, N. Y.

FIG. 9—TEAPOT LADLE USED TO RECEIVE STEEL FROM THE ELECTRIC FURNACE—THE METAL RISES THROUGH AN OPENING AT THE BOTTOM OF THE SPOUT

A unique condition governs the direction of this furnace and its operation. The melter is in all cases subject to the guidance of the metallurgist who presides over a small but complete chemical laboratory located within a few steps from the furnace. In many foundries the melter and chemist co-operate but the melter runs the furnace, and consults the chemist only for information on the progress of the heat, and the compositions obtaining. In this plant, however, the metallurgist is skipper and the melter is first mate.

When a casting emerges from the sand in this shop its progress is only partially complete. Near the shake-out floor is a track which leads directly into sand-blast room. This sand-blast installation, which was built by the Pangborn Corp., Hagerstown, Md., permits the debris removed from the castings, together with the used abrasive to drop through a grated floor. It then passes through a separator which delivers the clean sand to a storage bin for reuse. All castings are thoroughly sand-blasted as they rest upon a small car on the narrow-gage track within the sand-blast room. They then are shoved out onto a turntable at the back through another set of doors. From this point, the casting car is shunted on into the grinding and shipping room adjacent, or else is rolled upon another track which runs to the annealing oven located parallel with the sand-blast equipment on

## Table II

### Chart for Studying Causes of Defective Castings

Day of the Month

| Causes of defectives | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | Total ea. | Per cent defective |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bad metal | 4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4 | 0.022 |
| Bad molds | | | | | 5 | | | | | 1 | 10 | | | | | | | | | | | | | 6 | | | | | 21 | 0.116 |
| Blowy (mold) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Blowy (metal) | | | | | | | | | | | | | | | | | | | | 4 | | | | 7 | | | | 11 | 22 | 0.121 |
| Castings broken | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Check-hot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cold shot | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cold metal | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cope reversed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Core crushed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Core mis-set | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Core omitted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Core raised | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Core shifted | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Core wrong | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Composition (off) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Dirt | | | | | | | | | | | | | | | | | | | | | | | | | | 3 | | | 3 | 0.016 |
| Gated incorrectly | | | | | | | | | | | | | | | | | | | | | | | | 2 | | | | | 2 | 0.011 |
| Lost | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oxidized | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Porous | | | | | | | | | | 29 | | | 18 | | | | | | | | | | | | | | | | 38 | 0.210 |
| Runout | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Shifted | | | | | | | | | | | | | | | | | | | | 1 | | | | | | | | | 1 | 0.0055 |
| Shrinkage | 1 | | | | 1 | | | | | | | | | | | | | | | 3 | | | | | | | | | 5 | 0.0310 |
| Slag | 1 | | | | 1 | | | | | | | | | | | | | | | 5 | | | | 8 | | | | | 15 | 0.0930 |
| Tests failed (physical) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tests (cut up for) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Thin section | | | | | 1 | | | | | 1 | 1 | | 2 | | | | | | | 2 | | | | | | 4 | 59 | | 70 | 0.3870 |
| Washed | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wrong grade | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | | | | | | | | | | | | | | | 181 | 100.0 |

Number of castings made during month..... 2678
Per cent rejected by number..... 0675
Total weight rejected 7751 lbs.; shipped, 80,546 lbs.; 9.6 per cent;
Per cent welded, 0.225; Number welded, 613.

the same side of the molding floor.

The annealing furnace is 5½ x 10½ feet inside, and 4½ feet high. It is oil-fired through three burners, two located near the bottom of the firing chamber at one side and the third on the opposite side near the roof. Pyrometric control is attained through three thermocouples, one midway of the side having the two burners with the other two, spaced equally on either side of the third burner, which is located on the opposite wall.

The pyrometers were made by Leeds & Northrup, Philadelphia. The sand sealing arrangement may be noted from Fig. 7. As the fire-brick paved car is shoved into the furnace, the overhanging sides of the car slide into the sand in the two troughs, one of which is at the left of the door. This seals the furnace at the bottom, and the door drops upon the extending end of the car platform and forms practically an air-tight closure at the front of the oven.

*Controlling the Anneal*

Great care is exercised in annealing. A study of the intended uses of the castings is used as a basis, and the method of anneal is varied to suit the requirements. Small castings are annealed up to 1650 to 1675 degrees Fahr. The temperature is raised gradually and held for from 3½ to 5 hours for a 0.30 per cent carbon steel. The castings then are cooled in the furnace, removed and cooled in air, or quenched in a tank of water directly at the side of the runout track from the furnace, as may be desired. The quenching tank is merely a boiler shell buried to its rim and protected by a wooden cover when not in use. The temperatures obtained in all parts of the furnace chamber are practically the same. The variation between the three thermocouples is seldom found to be over 10 to 15 degrees.

The shop is liberally equipped with molding machines, swing and stand grinders, sand mullers and handling equipment. The medium sized flasks are handled from molding machines by air-operated jib cranes, and the main bay is served by two electric overhead girder cranes each rated at five tons.

Sand is carried from the shakeout floor to a corner of the shop where an overhead bin feeds down into a Simpson grinding pan, manufactured by the National Engineering Co., Chicago. Outside sand storage is adjacent to this point, and the new material is wheeled to the mixer. Core sand is mixed on the opposite side of the shop near the core department. Three large core ovens provide ample facilities for the great number of small cores needed in this plant. These are all coke fired.

## Perfect Convention Plans

Preparations rapidly are nearing completion for the Inter-Allied Foundrymen's Congress and Exhibition which will be held in Philadelphia during the week of Sept. 29. The committee on papers announces that 34 addresses and papers have been secured to date. These cover every phase of the foundry industry. It is practically assured that the technical material prepared will be sufficient to provide special sessions to consider gray iron, malleable iron and steel problems. The broad questions of management and personnel also will be discussed.

More space already has been reserved for the machinery and equipment exhibition than the total required for any previous convention. Excellent facilities for exhibiting equipment are provided at the Philadelphia Commercial Museum and many manufacturers will avail themselves of the opportunity to demonstrate new and improved machinery.

The committee of the Philadelphia Foundrymen's association is providing an extensive program of entertainment, to include some interesting visits to local manufacturing plants. It is planned that these inspection trips will be schedu'ed so that they will not conflict with the technical sessions.

President A. O. Backert, who has just returned from an extended trip to England and France, reports a lively interest abroad in the foundry industry of America. The cordial invitation extended by Mr. Backert to the various associations of foundrymen of the allied nations will no doubt result in a large foreign attendance.

FIG. 10—METHOD OF HOLDING ROLLING MILL SPINDLE FOR GRINDING THE END AFTER REMOVING THE GATE

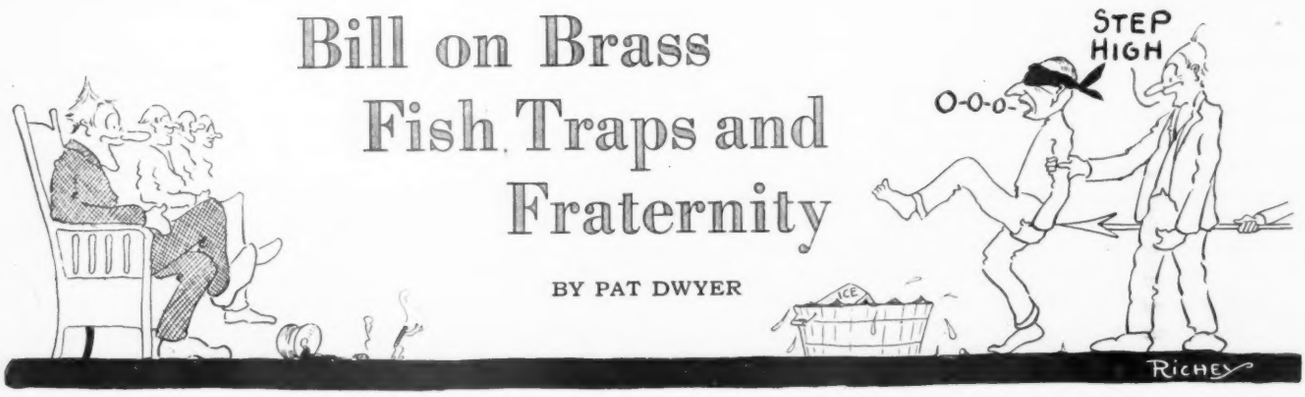
## Starts New Brass Foundry

Operations have been started at the newly completed plant of the Adrian Brass & Aluminum Castings Co., Adrian, Mich. This foundry was recently organized by Mr. Bachrach of Adrian, and W. G. Snyder, of Detroit, who formerly had charge of the Thiery & Kendrick Mfg. Co., and the Detroit Motor Castings Co., foundries. Mr. Bachrach is president of the new company, and Mr. Snyder is general manager. The foundry equipment, which was furnished by Frederick B. Stevens, Detroit, includes modern type molding machinery, sand-blast tumbling barrels, grinding equipment and 10 natural draft type crucible furnaces which give a melting capacity of five tons per day.

The Root & Van Dervoort Engineering Co., East Moline, Ill., manufacturer of automobile and tractor engines, has increased its capitalization from $1,346,200 to $7,500,000. Manufacturing facilities and production will be increased. W. H. Van Dervoort is president and manager, O. J. Root and Rufus Walker, vice presidents.

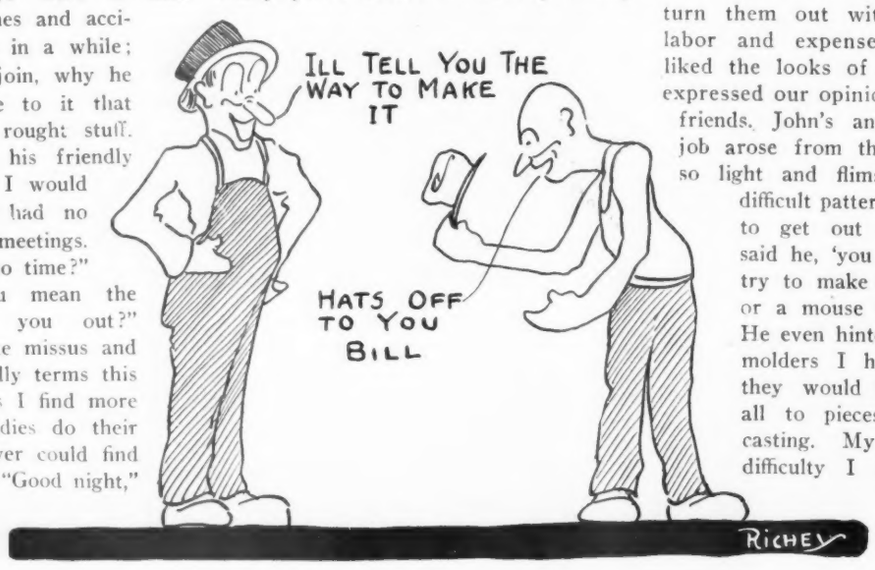
# Bill on Brass Fish Traps and Fraternity

BY PAT DWYER




A FRIEND approached me the other day and suggested that I join the local lodge of world-famous order, The Free and United Order of Fraternal Flying Foxes. He dilated at great length on the advantages of a membership in this august and exalted body and for a clincher he mentioned the names of several mutual friends, including Bill, who were already members. I told him I would consider the matter. The next time I met Bill I asked him about it. He was quite enthusiastic and advised me strongly to join. I gently inquired if he had ever read Aesop's fable of the "Fox Who Lost His Tail." He said no but of course any thing was liable to happen at the initiation. The boys were a little high spirited sometimes and accidents do occur once in a while; but if I wished to join, why he would personally see to it that there would be no rough stuff. I thanked him for his friendly interest, I told him I would like to join but I had no time to attend the meetings. "Whadda ya mean, no time?" said he. "Do you mean the missus won't let you out?" "Oh, no," I said, "the missus and I are on right friendly terms this year; but the fact is I find more fun helping the kiddies do their homework than I ever could find at lodge meetings." "Good night," said Bill, "you have my sympathy." "Not at all," I said, "not at all. When I was first appealed to for assistance I don't mind admitting that I looked upon it as a penance or a punishment for some of the deeds of a wild and unregenerate youth; but after a while I grew to like it. Things like grammar and arithmetic which I cordially detested when going to school, I now find are not so dreadful after all. I can juggle fractions and decimals now without any effort. I can spot the nouns and adverbs and other parts of speech without incurring a headache, and when there is no hurry, I can take sentences apart and put them together again without the aid of either a can opener, a monkey wrench or a screw driver. It is funny the way things come back to one. I learned all that stuff against my will when I was young and I certainly tried hard enough to forget it after I left school, and yet here at the slightest provocation the old rules and regulations come trooping back into my mind."

"Yes," said Bill, "there are few things that a man learns, but come in handy some time. Now I had a couple of queer looking castings to make not long ago and I adapted a scheme which I had seen used a good many years before in a shop nearly 2000 miles away. The castings wanted were known as baskets for fish traps. The main body of the fish trap was to be made of cast iron and had several interesting molding features about it. I'll tell you about it some other time. The basket was part of the main intake of the water supply pipe for a blast furnace and it's function was to act as a strainer. The water was pumped direct from the harbor and naturally any foolish fish who happened to be prowling around the intake were sucked into it.




BILL KNOWS HOW TO MAKE IT

"The basket I speak of was to be made of brass with a flange around one end machined to a water-tight fit and with the lower end resting on the bottom of the trap casting. After the basket frame was made it was lined with thin sheet brass perforated with ¼-inch holes. The casting was 36 inches in diameter and 36 inches deep. As you may see from the sketch it consisted of a flange with 12 ribs attached. These ribs were bent at the bottom at right angles and were held together in the center by a circular disc six inches in diameter.

"When the drawing appeared in the pattern shop John good naturedly consulted me about ways and means to turn them out with a minimum of labor and expense. Neither of us liked the looks of the thing and we expressed our opinion freely as among friends. John's antipathy toward the job arose from the fact that it was so light and flimsy it would be a difficult pattern to make and easy to get out of shape. 'Why,' said he, 'you might just as well try to make a canary bird cage or a mouse trap as that thing.' He even hinted that some of the molders I had were so strong they would knock the pattern all to pieces making the first casting. My objection was the difficulty I foresaw in closing the mold. The ribs were perpendicular and whether we molded the flange up or down, one face of the mold had to slide past the other in closing the mold. If we shaved the mold for clearance there would be all kinds of fins to be chipped off and you know what a nice job that would be on a fragile casting.

"'John,' said I, 'I'll tell you a way to make that thing and you won't need to make any pattern.' 'Pleased to meecha,' said John, 'your proposition interests me strangely.'

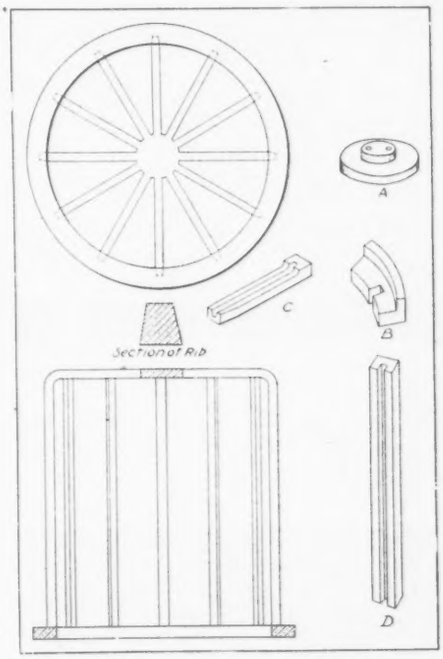
"'Well, perhaps I should qualify

that statement,' I said. 'You need not make any pattern but you will have to make a sweep and 3 or 4 coreboxes.' 'Don't say any more,' said John, 'I'll be right there with bells on. Would it be indiscreet to inquire if that was an inspiration or did you ever make them before?' So I told him how I happened to think of the method.

"During my young and palmy days as a happy buck molder it was my pleasant habit to flit from place to place every few months. Times were good in those days and I had no trouble in getting a job in any town I hit. I had neither the inclination, the ambition or the gift, you may call it what you like, to drink up all the beer in every town. As a result my recollection of the various hamlets I favored for a while with my company remains perfectly clear. I did not make the principal jobs in all these shops and candor compels me to admit that none of them closed down when I left, but I picked up some information in each of them. I did not think much of some of the schemes I saw, but others were certainly worth remembering. I was not long at the business before I discovered that suggestions for improvements in rigging or methods were not encouraged by the average foreman. I suppose they considered it a reflection on their ability, and being human and wishing to hang on to their jobs they just naturally discouraged any thing of that kind. I have worked in some shops where the opposite was the case and if the foreman was a competent man I never found that it detracted from his prestige. However, that has nothing to do with this history.

*The Little Idea Germ*

"I worked in a shop one time which was devoted principally to the production of power transmission machinery. Pulleys were made of all shapes and sizes with single arms, double arms, wide faces, narrow faces, solid and split, straight, crowned and grooved faces. To make a pulley with a grooved face, a ring and arms of the required size were selected and rammed up in the usual way. The face of the mold, however, was made about four inches wider than the required face of the casting. After the inside was rammed and the heart-shaped plates between the arms firmly bolted to the cover plate, the ring pattern was drawn. Hooks in the cover plate were then engaged and half the core was lifted. The pattern for the arm and hub then was removed and the top half of the mold lowered into place. Now there is nothing strange in all this but here is the interesting part. The outside was made in cores, 6, 8, 10 or more segments depending on the circumference of the wheel. These segment cores containing the grooves were laid up against the face of the mold. They had a projecting flange top and bottom which came in contact with the green sand thus regulating the thickness of the rim. When they were all in place sand was shoveled in back of them and rammed firmly. Now there is nothing to hinder us from adapting that idea to this thing.




HOW THE PATTERN WAS MADE

'No,' said John, 'its a regular cinch; wait 'till I show you something.'

"He went over to the beautiful roll top desk where he keeps his blue prints, books of reference, victory bonds, cigarettes and other valuables. He selected a sheet of paper, brought it over to me, and I hope I may die if he didn't have the same scheme all worked out. 'What do you think of that?' said he. 'Oh,' said I, 'that just goes to show what associating with a superior intellect will do for a man.'

"'Superior grandmother,' said John, 'I was making them kind of things when you were running around with only one garter and wiping your nose, on the few occasions you did wipe it, on the cuff of your coat sleeve.'

"'I knew they made baskets on the Indian reservations,' I said, 'but I never heard of them making brass ones.' John had no comeback to that, so he simply said, 'I will lay this out full size on the board and then we can see just exactly where we are.' Of course I can't make as neat and classy a job of it as John did, but this sketch will give you an idea of what it looked like. 'Now,' said he, 'there is the basket and since it does not make any difference which end is up, we will cast it flange down. I'll make you a sweep for the inside and a set of coreboxes for the outside and then *anybody* can mold it.' He accented the word anybody in a most offensive way.

"'There are the four cores *A, B, C* and *D*, and since there are two castings to be made there will be 24 of each of them except *A*, and there will be only two off that.' 'Good work,' said I, 'go to it, me boy.'

*Making the Job*

"He distributed the jobs around the shop and next day brought over the sweep and coreboxes. The coremaker made the two sets of cores and shoved them in the oven. We set up the spindle and centered a 31-inch pulley ring pattern around it. Inside this ring we drove four stakes in a square about two feet apart. These stakes came within one inch of the top of the core and were designed to act as stiffeners. The ring we had was only a foot deep so we kept drawing it up and laying a course of rods at every ramming until the sand was the required height, when the ring was taken off the sweep run around a few times and the inside of the mold was made. The spindle was then taken out and set up for the other one and the same proceeding gone through with. The cores were next brought over and set. The flange cores *B* rested on the bottom and butted up against the face of the mold. Then the upright cores *D* were placed. These were located on the bottom by fitting the rib in the long core to coincide with the short piece of rib in the flange core. With the aid of a pair of trammels they were properly spaced at the top and a couple of six-inch spikes inserted on both sides of each core to hold them in place. Then the top cores *B* were put on, the outside ends resting on the upright cores thus locating them properly. The inside ends were cut on radial lines hence when the cores were assembled they automatically located themselves. In order to provide metal thickness for a disc in the center the core *A* was then set. It did not rest on the green sand but had a shoulder to rest on the other cores. This left an opening under it the same thickness as the ribs. This core also had two 1-inch holes through it for gates.

After the cores were all arranged in both molds we borrowed two sections of a 4-foot smokestack from the boiler shop and placed one around each mold

as a curbing. This curbing was packed full of sand. We bedded a round plate on top of each, fastened them down and built up the pouring basins.

"We had only one brass furnace and it was rather skimpy for a 300-pound pot so I decided to melt enough for both castings at one time in the cupola. Accordingly after pouring off the regular heat of iron we threw in a few shovels of coke and charged the brass, which, by the way was all scrap. In a few minutes the metal was tapped, swung around to the mold and the casting poured. Well, sir, you ought to have seen them when they were shook out, there was not an hour's chipping on the two of them.

"Well," said Bill, "I'll have to move along, I was on the way to lodge meeting when I met you. I'll propose your name tonight so you had better begin saving up to buy your regalia, because they never black-ball a molder."

# Operating a Plant for Foundry Welding

A CENTRAL oxyacetylene welding plant is operated by the Western Foundry Co., Chicago, in connection with its shops in that city for keeping the flasks and other equipment in good condition and for other purposes. This plant presents several features of interest.

The overhead monorail system which serves the various foundry departments also connects with the welding shop; heavy castings are easily transported by this means while the lighter castings are either conveyed in the same way or by wheelbarrow.

The welding shop is a small isolated brick structure arranged as shown in Fig. 3. It is a one-man plant, a single attendant doing all the welding as well as looking after the acetylene generator. The foundations, floors and roof are reinforced concrete. The building is divided into two rooms each about 13 feet high.

The generator compartment is entirely separated from the welding room by a solid brick wall, in which there are no doors, windows or openings of any kind. Thus there is no way in which the acetylene can leak from one room to the other. There are no electric or other lamps or wires

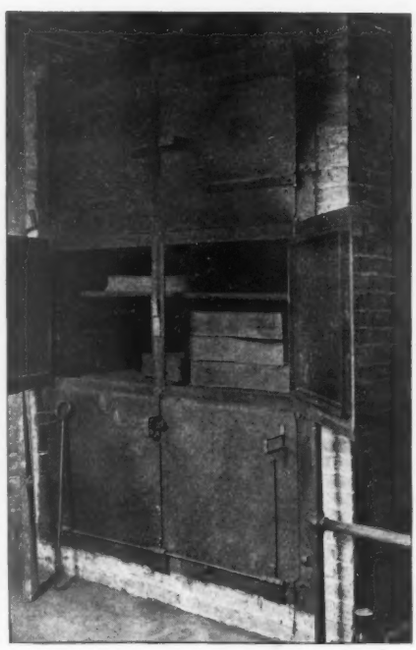


FIG. 1 — PREHEATING OVEN IN WHICH THE CASTINGS ARE WARMED UP BEFORE WELDING

in the generator room, light being furnished by two windows of ample size. A "No Smoking" sign impresses its message most forcibly by means of a glaring red skull and cross bones. The acetylene generator is of the low pressure type and is amply equipped with safety devices. The installation consists of a generator proper and gas holder, the latter being provided with a weighted water sealed gas bell, which maintains a steady flow of acetylene at absolutely uniform pressure. The unit under discussion has a carbide capacity of 50 pounds per charge which is equivalent to a normal gas capacity of 50 cubic feet per hour.

A water faucet and a short length of hose for adding water to the generator or for flushing out the carbide residue are located on one side of the room; the empty carbide cans are also stored on this side. The full cans are kept on the opposite side away from the waterpipes. The residue flows by gravity into a covered trough and thence into a pit outside the building.

The generator is rendered fool proof with a complete and efficient system of interlocking safety devices which prevent mistakes in operation due to carelessness or forgetfulness when charging the generator.

After passing through the filter connected with the generator the acetylene passes through a hydraulic back pressure valve which is shown near the floor in front of the gas holder.

This valve is water sealed and prevents oxygen from flowing back into the generator. The gas holder and the back pressure valve are vented to the open air above the roof. These vents provide a means of escape for the gas in case the pressure should build up on account of abuse of any kind. A positive force-feed mechanism supplies the carbide to the water in the right proportion according to the demand for gas which leaves the apparatus through a 1½-inch pipe. The large water capacity of this generator which provides for not less than one gallon of water to the pound of carbide charge is said to insure cool, efficient generation of gas.

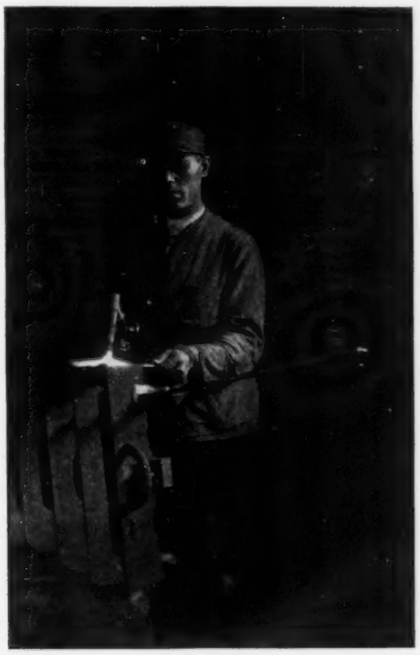


FIG. 2 — WELDING THE SIDE OF A BROKEN FLASK. NOTE ADJUSTABLE CLAMP

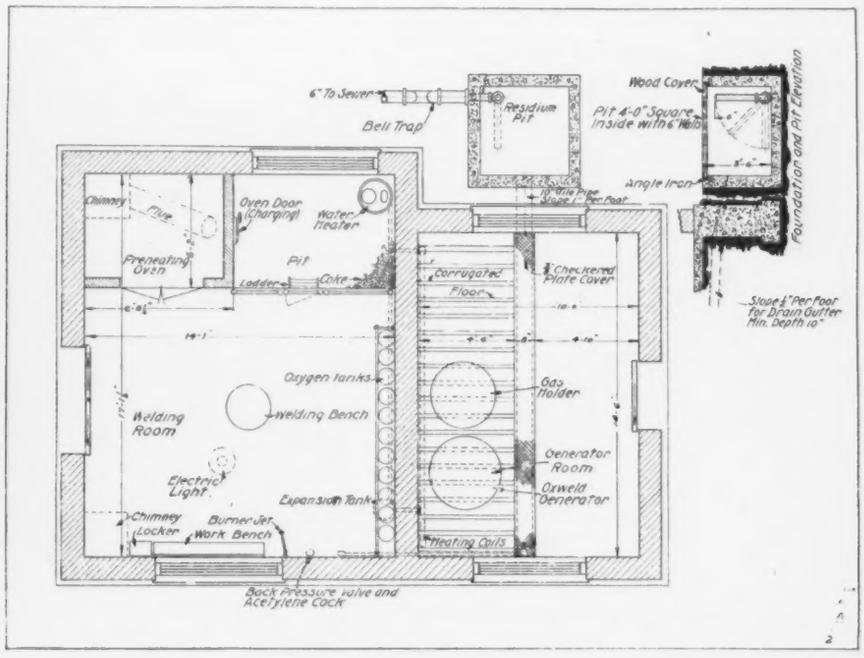



FIG. 3—LAYOUT OF WELDING AND GENERATING ROOMS—NOTE HOW THE OXYGEN TANKS ARE STORED NEAR WELDING BENCH

The welding room is arranged as shown in Fig. 3. It is well illuminated and ventilated by two windows and additional light is provided when desired by an incandescent electric lamp conveniently located directly above the welder.

A small hot water heating stove and a three-part preheating oven form the remainder of the equipment for welding.

About a dozen oxygen tanks are kept on hand; they are stored against the back wall of the welding room and are enclosed by a hinged railing. The welding equipment consists of an Oxweld blowpipe with several sizes of heads, besides the proper regulators, hydraulic safety valves, etc. The entire installation was designed and executed by the engineering department of the Oxweld Acetylene Co., Chicago.

## Status of Domestic Graphite Supply

Although the flake graphite supply in normal times comes from Madagascar, the United States can be fairly independent in case of necessity if graphite mining in this country is sufficiently stimulated, the United States tariff commission states in a report on the graphite situation which is to be presented to congress in connection with proposed tariff legislation. Until the full utility of domestic flake in crucible making is established and until the possiblities of artificial graphite are more fully known, it is pointed out, it is impossible to predicate the effect on the graphite mining industry of varying degrees of tariff protection. Graphite has been on the free list under the name of plumbago since 1872. From 1846 to 1872 there was a duty ranging from 20 per cent to $10 a ton on such articles as plumbago or black lead.

In the graphite industry, interest centers in the material capable of being made into crucibles, the crystalline variety of the mineral. In addition to its use in crucibles, it has a wide variety of industrial applications, including foundry facings, batteries and stove polish, for which a lower grade, the amorphous variety, is adapted.

While the domestic production of graphite doubled in 1916 and there was a further increase of 50 per cent in 1917, the imports also increased. About one-sixth of the domestic consumption was of domestic origin in 1916 and about one-fourth in 1917. During 1918 about 40 per cent of the total supply in the United States was of domestic origin.

The commission says about 15,000 tons of graphite have been required each year and deposits in Montana, Alabama, Pennsylvania, New York, Alaska and Texas produce about 3500 tons of flake annually, of a grade inferior to Ceylon but similar to Madagascar flake. There are large undeveloped reserves of flake graphite in the United States carrying 5 per cent of the material. The graphite content of Ceylon and Madagascar averages 50 per cent or more.

Artificial graphite and graphitized carbon manufacturers, it is declared, are competitive to some extent with natural grades. The American product is manufactured chiefly by the International Acheson Graphite Co., which utilizes electric power generated at Niagara Falls. The output has increased greatly in recent years and now forms an important element in the country's graphite supply.

"Although not yet an accredited substitute for flake graphite in the making of crucibles," the report says, "it is not improbable that present efforts to develop an artificial crucible grade will finally evolve a satisfactory product. It is already finding an expanding use in lubricants, paints, foundry facings, boiler scale preventives, and battery fillers, and the manufacture of graphitized carbon electrodes at Niagara Falls is increasing with the expansion of the electric-steel casting industry."

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Robert B. Carolin, bronze and aluminum founder, has removed to a new plant on Military avenue, Detroit.

# Using Metal Denseners and Molds

## Sponginess in Connecting Sections Between Thin and Thick Casting Parts, it is Stated, May be Remedied by Metal Denseners Properly Used— Permanent Metal Molds are Recommended

By E. H. BROUGHALL

IN many instances where it is practically impossible to get a sound casting by the usual methods of feeding the problem may be solved by the judicious use of proper denseners, or permanent molds. The use of denseners is not new. The writer's experience with them goes back nearly 20 years. The first instance he can remember of using them was in the liner of the old Wolseley horizontal cylinder motor car engine. This particular engine cylinder was made on the same lines as an ordinary gas engine cylinder, *i. e.*, with a liner which was inserted into a jacket casting, and it was in the making of this particular liner that the writer first used denseners. The densener here used was really a metal core.

### *Origin of Denseners*

It is only fair to point out that these liners were cast with a densener following the instructions of the Wolseley Co., and the author thinks that great credit is due to whoever was responsible for the instruction.

For purposes of discussion the subject of denseners may be considered in two main divisions:

First, the use of ordinary denseners for equalizing the rate of cooling between a thick and thin portion of a casting.

Second, the use of permanent molds for the production of sound castings, which are most difficult to produce by the ordinary molding methods.

It is understood that the necessity for denseners is caused through the uneven rate of cooling of thick and thin parts adjacent to each other. Foundrymen are quite conversant with the phenomenon of the cooling of molten iron, and it is well known that the slower the rate of cooling, the greater the growth of the crystals. Moreover, a thin part adjacent to a thick part will, under ordinary circumstances, draw metal from the thicker portion owing to the quicker cooling of the thin part, leaving a spongy section at the junction of the two.

To a great extent these troubles are overcome by the judicious use of denseners, which are simply intended to equalize as nearly as possible the rate of cooling between the slow cooling thick part and the quick cooling thin part. It is important in designing a densener to make it of such dimensions that it will actually equalize, as near as possible, these cooling rates.

If this is accomplished, it is easy to see that it will be impossible for the thin part of the casting to draw metal from the thick part because the thick part of the casting will be frozen at the point where the thin part joins, thus preventing the thin part drawing metal from the still molten thick part. In addition to this, the accelerated cooling of both parts makes the metal more dense.

FIG. 1—MILLING MACHINE KNEE AND SADDLE CAST WITH DENSENERS USED ON THE SLIDING SURFACES

### *Should Avoid Chill*

In the use of denseners, it is of the utmost importance to have a ready means of checking the hardness of the mixtures used, and it must be clearly understood that it is not advisable to use denseners when using a hard mixture of iron, owing to the fact that in such a mixture something beyond density is obtained. This is in effect a definite chill, which it is practically impossible to machine.

In the first place it is important that every consignment of pig iron delivered should be chemically analyzed, and a record kept of the result. Moreover, some easy means of checking the hardness of the mixture made must be adopted.

The readiest and most reliable means the author knows for doing this is by the well known Keep's shrinkage test bar. This method has been in use by the author for many years. The necessary apparatus is simple to make and the information derived from its use is of a most valuable character.

By the use of this apparatus the bars are chilled at the ends through coming in contact with a cast iron yoke, and the amount of chill and shrinkage of the bar determines the hardness of the mixture so tested.

It has been mentioned on several occasions that the hardness near a densener has been overcome by getting the densener away from the casting as soon as possible after casting, but the writer does not altogether agree with this. In cases where appreciable chill appears when a densener is used, it is probable that a wrong mixture of iron has been used, and if a correct mixture of iron is substituted the trouble of chilling is almost nonexistent. Moreover, in many cases it would be impossible to remove the denseners.

### *Denseners Are Recent*

Up to 14 years ago no denseners whatever were used in our foundries, and the introduction of them was caused through a considerable amount of trouble we were having with certain important castings. The first of these castings was an end cover for a feed pulley, having a thin plate, and a fairly thick boss adjacent. This cover was always on view in the finished machine, and it was most important that the casting should be clean and sound, but when the casting was made under ordinary conditions, there was invariably a spongy place at the junction of the thin plate and the heavy boss. To overcome this trouble a densener was used at the junction of the plate and boss. The writer well remembers what an exceedingly careful job was made of these particular denseners. They were carefully machined all over exactly to

Abstracted from a paper presented at a recent meeting of the Birmingham branch of the British Foundrymen's association and the Staffordshire Iron and Steel Institute.

the shape of the pattern. Of course, since that time it has been found that it is altogether unnecessary to machine denseners of this description, ordinary castings being used for the purpose. The use of the densener on this casting readily overcame all the trouble we had been experiencing, and whereas our scrap on these castings previously had been high, it disappeared altogether when the denseners were introduced.

The other casting was also difficult to produce by ordinary methods. In this casting ½-inch holes were drilled through the center, leaving only a small wall of metal between each hole. The difficulty here was that the casting, which had to be made solid, was always somewhat spongy in the center, due, of course, to slow cooling and the formation of large crystals. The drill in passing through the spongy portion was drawn out of line and invariably broke into the adjacent hole. This trouble was overcome by making this particular casting in a permanent mold.

Since that time there is hardly a casting we make without using a densener on some part of it, and hundreds of castings which it would be impossible to produce as sound as they are required in sand molds, now are easily produced in permanent molds.

Another important use for denseners, besides equalizing the cooling between thick and thin parts, is to make more dense certain parts of castings which form slides, such as the sliding surfaces of milling machine bodies, knees and saddles, the ways of lathe beds, the sliding surfaces of lathe bed saddles, etc. By doing this not only are these surfaces produced sound and clean, but owing to the density of the metal of these parts considerable life is added to the machine. In high class machine tools such as milling machines and turret lathes, this is a most important point, because if sliding surfaces such as those mentioned, wear considerably, the whole alignment of the machine is upset. Fig. 1 shows a milling machine knee and saddle cast with denseners.

It is our practice to use an ordinary machinery mixture to make denseners, but we do not use a densener more than two or three times. Practically all our denseners are made on molding machines at a low cost and as the metal is the ordinary mixture, the denseners can be melted up again after being used. Where it is required to use denseners for a considerable time they should be made of a very hard iron with low silicon.

## Table I

### Chemical Analysis of Sand and Permanent Mold Cast Test Bars

| Sample | Total carbon per cent | Graphitic carbon | Combined carbon | Silicon | Sulphur | Phosphorus | Manganese |
|---|---|---|---|---|---|---|---|
| Sand cast ..... | 3.272 | 2.931 | 0.341 | 2.845 | 0.068 | 1.075 | 0.51 |
| Permanent mold cast..... | 3.272 | 2.645 | 0.627 | 2.774 | 0.081 | 1.060 | 0.49 |
| Sand cast annealed*..... | 3.272 | 3.081 | 0.191 | 2.774 | 0.077 | 1.075 | 0.50 |
| Permanent mold annealed*.... | 3.300 | 3.190 | 0.110 | 2.774 | 0.071 | 1.102 | 0.52 |

*Note method of annealing: Heated to 800 degrees Cent. for one hour and cooled to 500 degrees Cent. in six hours.

It must be distinctly understood that there is an enormous difference between the use of a densener and the use of a permanent mold. As has been shown, the use of denseners locally, simply accelerates and equalizes the cooling between thick and thin portions of a casting, at the same time making the metal more dense at the particular point where the densener is placed. With a permanent mold, however, the advantage of the densener as regards the accelerated cooling of the metal is obtained, and in addition to this, we get the benefit of an enormous amount of compression on the plastic casting. This is a claim to which exception is, and probably will continue, to be taken.

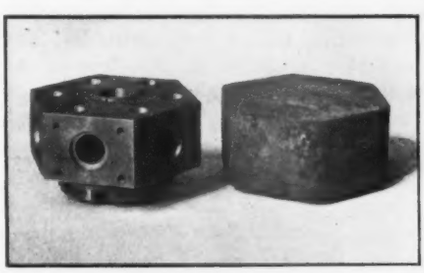

FIG. 2—HEXAGON TURRETS OR CAPSTANS FOR A TURRET LATHE REQUIRE A DENSE CASTING

The writer recently made some experiments which tend to prove that this compression does actually take place. These will be treated in another part of this article.

As previously stated, permanent molds properly designed, will produce sound and close-grained castings which are impossible in sand cast molds. One of the first castings we made in this way was a small hexagon turret used on a capstan lathe. In its casting form this is a solid block of metal, hexagonal in shape, 10 inches across the flats and 6 inches deep. This turret is machined all over, polished on the top, scraped on its six faces, bored from top to bottom for the turret post, and has a tool hole bored in the center of each of the hexagonal faces, also a pad hole in each tool hole for holding the tool. It is of the utmost importance that every one of these holes shall be sound.

The difficulty in sand castings was that the center of the turret casting, due to the extremely slow rate of cooling, and formation of large crystals, was always porous. This meant that the hole for the turret post was never sound, and in most cases the tool holes also were porous. All this trouble was overcome by the use of a properly designed permanent mold, and since that time thousands of these turrets have been made without loss. Fig. 2 shows the casting as made in a permanent mold, alongside the finished turret, and from this it will be seen that there are no less than 13 holes which must be absolutely sound, besides numerous small holes and machined faces.

The permanent mold now used for this turret casting is extremely simple. At one time these particular molds were made in two halves, and connected by bolts and spring washers, but it was found that after a number of castings had been made in them a certain amount of wear took place at the joint, which, in time allowed room for a small fin. This fin caused considerable trouble, due to the fact that although an ordinary mixture of iron was used, the fin cooled so suddenly that it was actually white. Peculiar as it may seem, this chill struck back into the casting a certain depth, and it was practically impossible to anneal this particular hard streak, so that it could be drilled or machined readily.

## Table II

### Physical Tests of Sand and Permanent Mold Cast Test Bars

| Sample | Transverse: Load in lbs. | Transverse: Deflection, in. | Tensile: Max. stress lbs. per sq. in. | Compression: Decrease in length under 89,600 lbs. per sq. in. per cent | Compression: Load at fracture lbs. per sq. in. | Brinell No. |
|---|---|---|---|---|---|---|
| Sand cast ..... | 2646 | 0.14 | 25,300 | 2.35 | 114,800 | 170 |
| Permanent mold ..... | 3038 | 0.10 | 34,100 | 0.90 | 158,700 | 269 |
| Sand cast annealed..... | 2688 | 0.14 | 24,600 | 9.61 | 110,400 | 149 |
| Permanent mold annealed.... | 3864 | 0.15 | 39,000 | 1.00 | 159,200 | 217 |

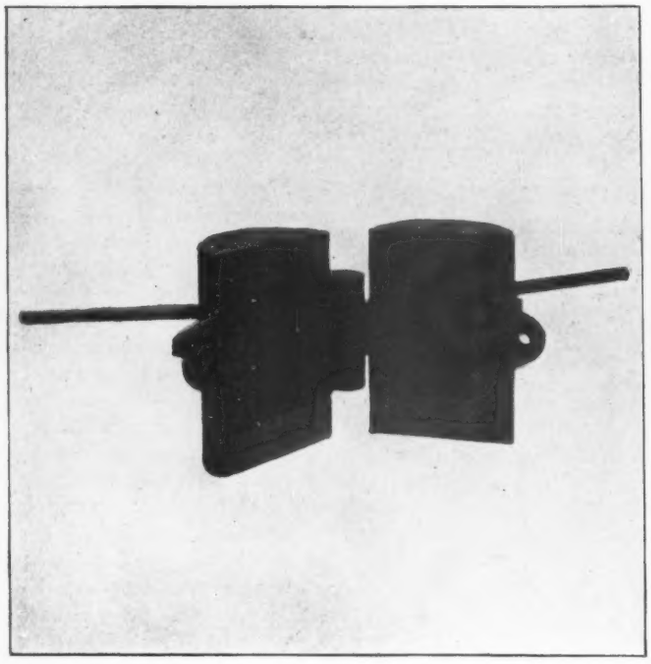

FIG. 3—EXPERIMENTAL MOLD TO DETERMINE THE INWARD STRESSES SET UP IN SOLIDIFYING CASTINGS FROM A MOLTEN CONDITION

FIG. 4—EXPERIMENTAL MOLD CLOSED AND WITH THE RECORDING DEVICE ATTACHED READY FOR THE METAL TO BE CAST

The permanent mold is simply covered by a sand top which carries a runner and riser. A few minutes after casting, the sand top is removed, and the casting turned out. This description practically covers the use of all permanent molds. One of the important points to watch in the design of permanent molds is to see that they are so constructed that the casting may be easily turned out. Furthermore, they should be massive enough to extract the heat from the molten metal in the quickest possible time. Some allowance also should be made to permit the mold to yield slightly at some point, as it is not commercially possible to make a permanent mold strong enough entirely to resist the enormous pressure that comes on the mold after the casting is poured.

### *Rust Makes Trouble*

Molds should never be used cold. Our practice is, never to let the molds get cold. After using each day, they are put back into a core oven and kept warm ready for use the next day. As a dressing, we use a simple mixture of plumbago, oil and molasses for wiping the mold over just before using. The addition of molasses makes the plumbago and oil stick to the surface of the mold. One important point to remember, however, is that permanent molds must not be used with the surface in a rusty condition, as good results cannot possibly be obtained if this is done.

It is advisable that all castings made in permanent molds should be annealed. Not because they are chilled to any extent, as this will not happen if proper mixtures are used, but because there is almost sure to be a skin hardness which is probably only a few thousandths of an inch deep, but for machining purposes it is advisable to remove this. The annealing may be done in an ordinary muffle furnace and

FIG. 5—PERMANENT MOLD CASTING SHOWING THE EXCRETIONS OF BEADS OF METAL AFTER THE INITIAL STAGE OF COOLING

small castings should be close packed in boxes with cast iron borings. The furnace should be heated up to a temperature of about 800 degrees Cent. in a period of eight hours. At this temperature the furnace should be allowed to cool and the castings remain therein until black hot. They then may be taken from the furnace and cooled in air while in the boxes.

Dr. W. H. Hatfield in his book on cast iron says "the annealing of gray iron inevitably leads to weakening of such material. When cementite is present this strengthens the material particularly in compression. A comparatively short exposure between 750 and 850 degrees Cent. is quite enough in foundry mixtures to precipitate this combined carbon from the cementite and so leave the iron weaker than as cast."

This argument, however, does not seem to apply in the case of iron made in permanent molds, due probably to the entirely different physical condition of such iron as compared with sand cast iron. This will be noticed in the series of tests described in another part of this article.

### *Machining Qualities*

Besides the benefits already enumerated from the castings made in permanent molds, another extremely important point as regards the machine shop, is the high speed at which gray iron made in permanent molds and annealed, can be cut. The writer has seen this material cut at the high speed of 300 feet per minute, and it is quite usual to cut at 200 feet per minute. The explanation advanced to account for this is that the combined carbon in the material is in a finely divided condition and evenly distributed throughout the casting. This, of course, has less effect on the cutting edge of the tool than if the combined carbon was in larger masses through the iron.

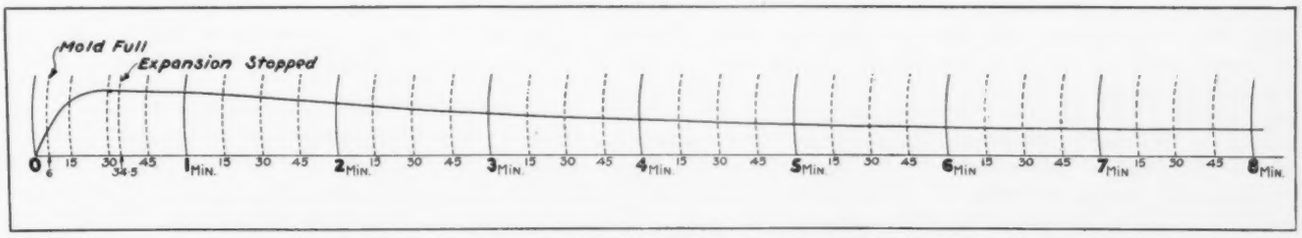


FIG. 6—CURVE OBTAINED FROM THE VARIATION IN EXPANSIVE FORCE DEVELOPED IN A PERMANENT MOLD

With reference to the physical difference between gray iron cast in permanent molds and the same iron cast in sand molds, there is no doubt whatever that iron cast in permanent molds is considerably improved in all physical respects by this treatment. In order to illustrate this, a complete series of tests have been made on the same mixture of iron cast in permanent molds and sand molds. The method of testing was as follows:

Two bars 1¼ inches square and 14 inches long were cast in permanent molds and two bars 1¼ inches square by 14 inches long, were cast in ordinary green sand molds, and the bars were cast as quickly as possible from the same ladle of metal, the mixture used being an ordinary mixture for machine tool castings.

### *Thorough Tests Made*

One bar cast in a permanent mold and one bar cast in a sand mold were annealed by heating to 800 degrees Cent. for one hour and cooled to 500 degrees Cent. in six hours. All four bars were then machined to exactly 1 inch square. Transverse tests were made with the bars supported at 12-inch centers.

Half of each bar was then machined to a tensile test piece, 0.564 inch diameter x 2½ inches parallel, with screwed ends and after the tensile test was completed, compression test pieces were made from the tensile bars, 0.564 inch diameter x ½ inch long. Brinell hardness numbers also were taken and a drill hardness test was made on each bar.

Chemical analyses were made and typical microphotographs at 100 diameters magnification were taken from portions of the tensile test pieces, so as to get structures as nearly as possible related to the tensile tests. Table I shows the chemical analyses of the various test bars used, and it will be noted that the greatest difference found is in the combined carbon content. In the sand cast mold this is 0.341 per cent and in the permanent mold cast bar this is 0.627 per cent. In the sand cast bar annealed, it will be noted that the combined carbon is 0.191 per cent; in the permanent mold bar annealed, it is 0.110 per cent. The graphitic carbon, of course, varies in close relation to the combined carbon. The method of annealing should be carefully controlled. The annealed bars were slowly heated to 800 degrees Cent. for one hour and cooled to 500 degrees Cent. in six hours.

Table II shows the results of the various physical tests and these are a clear illustration of the great improvement brought about by the use of the permanent mold.

Regarding the transverse test, it will be noted that the sand cast bar stood a load of 2646 pounds and that the sand cast annealed bar stood a load of 2688 pounds, but the permanent mold bar stood a load of 3038 pounds, whereas the permanent mold, annealed, bar stood no less than 3864 pounds, which is approximately 48 per cent greater load than that to which the ordinary sand cast bar was subjected.

With reference to the tensile tests, it will be noted that the sand cast bar stood 25,300 pounds; the sand cast annealed bar, 24,600 pounds; the permanent mold bar unannealed, 34,100 pounds, and the permanent mold bar annealed, no less than 39,000 pounds, which is approximately 54 per cent more than the ordinary sand cast bar.

The big improvement in the physical condition is again apparent in the compression tests. Under an 89,600-pound pressure the sand cast bar decreased in length 2.35 per cent; the sand cast annealed bar decreased in length no less than 9.61 per cent; the permanent mold bar unannealed, decreased in length 0.90 per cent and the permanent mold bar annealed, decreased in length 1.1 per cent.

### *Compression Tests*

Under a compression load which fractured the samples, the sand cast bar stood 114,800 pounds; the sand cast annealed bar, 110,400 pounds; the permanent mold bar, 158,700 pounds, and the permanent mold bar annealed, 159,200 pounds. It will be seen that these compression tests bear out the statements previously quoted from Dr. Hatfield's book on cast iron.

Although it is not advisable to place too much reliance on the Brinell hardness test, for cast iron, it will be noted that the test bars cast in permanent molds give a much higher Brinell number than those cast in sand, and it is safe to claim that this is additional proof of the extra density of the metal of the test bars cast in permanent molds.

This superiority is emphasized in the tests from the annealed bars. Annealing, carried out as previously stated, has had little effect on the transverse or tensile strengths of the sand cast

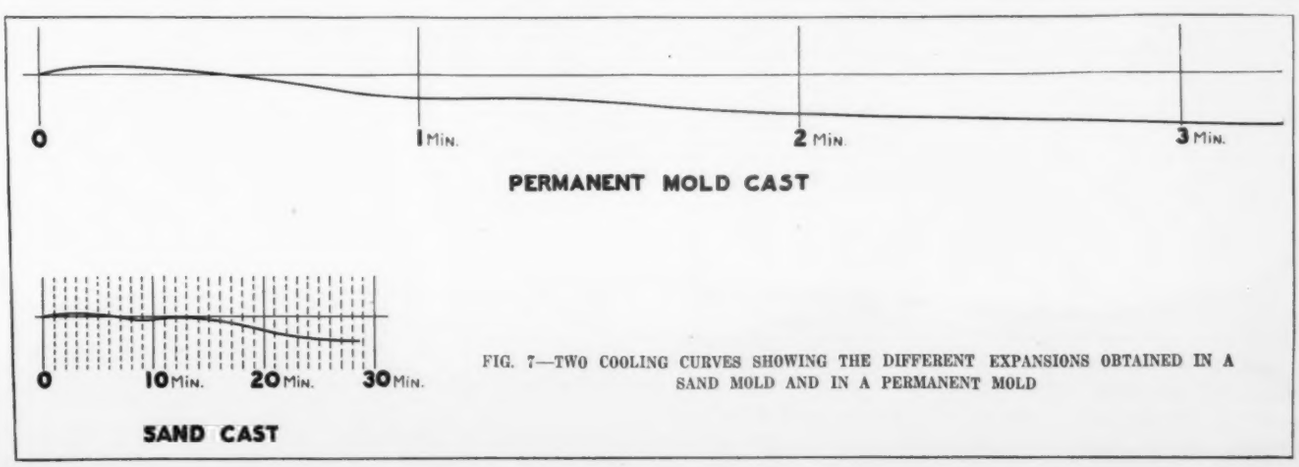


FIG. 7—TWO COOLING CURVES SHOWING THE DIFFERENT EXPANSIONS OBTAINED IN A SAND MOLD AND IN A PERMANENT MOLD

bars, but has caused a noticeable reduction in the resistance to compression. The same annealing has had an entirely different effect on the permanent mold castings. The resistance to compression is practically unaltered, but there is considerable increase in the transverse and tensile strength. The large deflection in the transverse test of the annealed permanent mold bar is worthy of attention.

The various improvements in the physical condition of gray iron when cast in permanent molds, in the writer's opinion, may be attributed to several causes. It will not be disputed that this improvement is brought about, to a great extent, through the exceedingly quick cooling of the iron which not only prevents segregation, but also prevents the formation of large crystals even at the center of a large casting. There is, however, another action taking place, which is virtually a compressive force acting on the iron in its plastic condition, compressing the iron and consequently improving its density.

In order to follow this theory it is necessary to have some knowledge of the action which takes place when iron is cooling. To those foundrymen who are not conversant with this the writer would recommend the study of Keep's book on cast iron. In this it is clearly demonstrated that during the cooling of cast iron, three distinct expansions take place. Illustrations are given of these cooling curves, the whole of which refer to castings made in sand.

### *Theory of Expansion*

From experiments made for the purpose of this article, it would seem that the cooling curve of metal cast in permanent molds differs considerably from the curves of castings made in sand molds. The writer made experiments to prove this, the apparatus used being similar to Keep's cooling curve recorder. The curves obtained seem to indicate that the first expansion comes on much sooner and more definitely when metal is cast in a permanent mold than it does in a sand mold, but that the second and third expansions are hardly discernible.

The author's theory is, that immediately after the iron is poured into a permanent mold, considerable and definite expansion of the iron takes place. In a sand mold this expansion has but little effect on the resultant casting, as the sand mold yields with the pressure, but in a permanent mold this expansion is resisted by the mold itself and turned into a compressive force.

Following this, the outer shell of the casting, to some considerable thickness immediately solidifies and quickly drops below the temperature of the third expansion. In this condition it is capable of resisting the second and third expansions of the metal as the permanent mold resisted the first expansion. All this resistance tends to put tremendous pressure on the castings, resulting in considerable density.

This theory has been criticized considerably. To prove the contention, however, the writer decided to attempt to produce definite proof that the theory submitted was correct. To do this a permanent mold was designed with a recording arrangement on it, whereby the expansion of the metal could be recorded through the movement of the permanent mold. This mold is shown in Fig. 3. It was equipped with a recording arrangement and dial, as shown in Fig. 4, for recording the amount of the expansion due to the pressure of the metal inside.

From these experiments the writer was enabled to produce a curve which he considers clearly establishes the fact that there does take place a considerable compressive force when metal is poured into a permanent mold.

Fig. 6 shows the curve that was obtained by this means and it will be seen from this that immediately after the metal entered the mold expansion took place, which in the particular instance under survey, continued for 34½ seconds. In ordinary practice this expansion would of course have been resisted by the permanent mold, and turned into compression.

At this point the expansion stopped and a gradual contraction followed for 4½ minutes, when no further movement of the permanent mold was recorded. At this stage, however, it is probable that the outer shell of the casting had become sufficiently solid to resist the second and third expansions of the metal. A further experiment was made with a device similar to Keep's cooling curve recorder, and Fig. 7 shows two cooling curves, one taken from a permanent mold and the other taken from a sand cast mold. In the cooling curve from the permanent mold it will be seen that a definite expansion takes place immediately after the metal is poured, and this expansion is considerably greater than the first expansion in the sand cast mold. Following this expansion, the curve indicates that contraction took place and one minute after pouring it would appear that this contraction was to some extent arrested. In fact, there is some evidence that the second expansion took place at this period. It will be noted that no record was obtained of the third expansion, and this is probably due to the fact that the outer shell of the casting had become so rigid as to entirely resist the last expansion. In the cooling curve of the sand cast bar, an expansion is distinctly seen at about 12 minutes after pouring. An important point to note in these two curves is that general shrinkage in the casting made in a permanent mold occurred at about 1¼ minutes after pouring, whereas in the sand cast mold this general shrinkage did not occur until about 20 minutes after pouring.

In order to further illustrate the enormous pressure which the writer believes takes place when molten metal is poured into a permanent mold, Fig. 5 is presented. This shows a small casting 3 inches in diameter and 6 inches long, made in a permanent mold. It will be noted that small pellets of metal have been extruded through the top of the casting. These pellets were forced through the solid crust of the casting two minutes after pouring, and this certainly indicates that a tremendous pressure was being exerted on the semi-plastic metal in the center of the top of the casting. Microphotographs showed that this metal which was extruded contained a considerably higher phosphorus content than the other metal of which the casting was made.

## Charging the Cupola

*By H. E. Diller*

*Question.*—I would like to have some information in regard to charging a cupola. We have a 30-inch cupola which is fitted with two rows of tuyeres. Should we use both rows of tuyeres during the entire heat? What amount of blast should we carry? How much coke should we put on the bed; we would like to know the weight as well as the distance it should extend above the tuyeres? What is the proper amount of metal to put on each charge?

*Answer.*—We recommend that you use both sets of tuyeres through the entire heat and that you operate with a 12 to 14-ounce blast. The coke in the bed should extend 25 to 30 inches above the tuyeres. This will require about 800 pounds of coke. The charges should be made up of 1000 pounds of metal and 120 pounds of coke, although the first charge might contain a few hundred pounds more of metal. It is always best to be sure you have enough coke, for this reason we are recommending more coke than you will find necessary after you have operated the cupola for a while. The proper amount can best be arrived at by gradually cutting down the weight of coke charged until you notice a detrimental change in the iron.

The American Pattern Works Co. recently has taken over the business conducted by the American Pattern Works, York, Pa., maker of wood patterns.

# Labor is Saved by Pouring Device

## Description of Device Invented by Cleveland Foundryman for Handling Molten Iron—Four Men Now do Work for Which Fourteen Were Required—Construction Simple

PROBABLY at no other time, except during the war, have foundrymen been under such urgent necessity of attaining the greatest possible production with the labor available. Mounting wages and scarcity of men demand efficiency. This can be done only by the more extensive use of mechanical appliances and in this direction the pouring problem probably offers as great an opportunity for progress as any other. In gray iron foundries making automobile cylinders and other relatively light castings, the task of pouring each day's heat is particularly arduous. This has led to the development of a large field for the application of mechanical pouring apparatus.

The accompanying illustrations show the details of one of the latest devices of this character, invented by Daniel Ryan of the Allyne-Ryan Foundry Co., Cleveland. Although designed primarily for automobile cylinder molds, the Ryan pouring device may be advantageously employed on any other work of similar character. The device consists essentially of a cylindrical ladle mounted on trunnions in such a way that the iron may be discharged through nozzles which become submerged when the ladle is rotated. The metal flows from the nozzles into two semicircular guide troughs which convey it to the runners leading to the mold. The entire apparatus is carried on a frame mounted on wheels which render it readily portable.

FIG. 1—MACHINE POURING A 6-BARREL CYLINDER

Fig. 1 shows the device in operation. The ends of the pouring basin are constructed of cast iron with a segment removed as shown in Fig. 3. The sides are made of heavy boiler plate perforated and securely riveted to the end castings. The inside of the basin is lined with one course of 1-inch fire brick. The basin is supported by trunnions which rest in sliding shoulders. The shoulders move in vertical guideways and are raised or lowered by an adjusting screw operated by a hand wheel. By this arrangement, the level of the pouring basin may be maintained and any depression in the track will have no effect on the iron level if the trunnion shoulders are adjusted. The rotary motion of the basin is controlled by a lever securely bolted to the

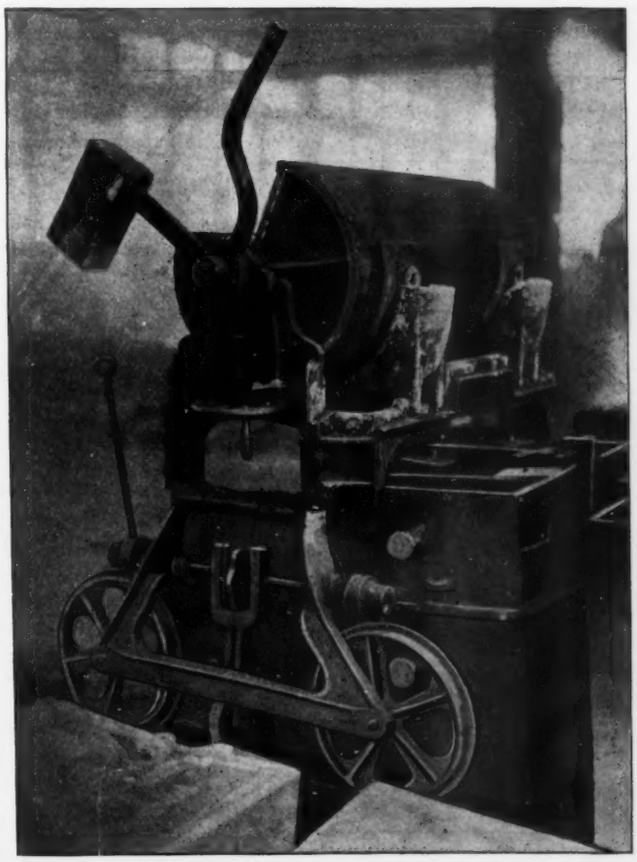

FIG. 2—SIDE VIEW SHOWING POSITION OF CANOE TROUGHS

FIG. 3—MACHINE IN POSITION TO RECEIVE CHARGE OF IRON

trunnion flange on the operator's side of the machine. An extension arm carrying a counterweight is provided; this offsets any danger of the basin turning over of its own accord while the iron is being poured into it from the crane ladle. Two cast-iron guide troughs rest upon the side frames and may be lifted off when it becomes necessary to reline them with clay. A 1-inch opening through which the iron flows to the sprues is provided in the bottom of each trough. The distance from the floor to the bottom of the basin is 3 feet 2 inches.

The entire device is supported by three flanged wheels—two on the operator's side and one on the helper's side—which run on rails spaced 4½ feet apart and permit the machine to be moved in a straight course over the molds. When several rows of molds are to be poured the machine may either be moved from one row to another by a traveling crane, or run to the end of the track and wheeled to the adjacent row of molds. For this latter purpose a lifting device is provided. It consists of two shafts equipped with an eccentric operated through cams which engage three pedestals. Each pedestal is equipped with a caster as shown in Fig. 3. One caster is placed between the two flanged track wheels on the operator's side of the machine and the remaining two casters are installed on the helper's side, there being one on each side of the flanged wheel at the ends of the carriage frame. Levers inserted in collars on the ends of the eccentric shafts actuate the cams controlling the motion of the pedestals. This raises the machine from the track and transfers its weight to the three casters.

The trunnion flange on the side of the basin is provided with a stop and when this stop is tight against the lug attached to the trunnion slide, the basin is in position to receive its charge of iron. This position is shown in Fig. 2.

When the basin has been filled the operator moves the machine over the flask to be poured and by means of the pouring handle tilts the basin so that the iron is discharged through the openings into the guide troughs. In Fig. 2 these openings are shown just clear of the tops of the guide troughs. The metal is discharged from the troughs into the sprues directly underneath.

The basin holds enough iron to pour four 6-barrel or seven 4-barrel automobile cylinder castings. It is said that two machines will take care of the output of a cupola which melts between 18 and 20 tons per hour and that only four men are required. Bull ladles required 14 men.

# Cupola Not Suitable For Melting Bronze

By J. PEARSON

MY attention has been directed to several articles which appeared in THE FOUNDRY recently dealing with the subject of melting brass and bronze in the cupola. I have melted a considerable quantity of nonferrous metal in that way during a period of 25 years and my experience points to the fact that the well known gun metal consisting of copper 88 per cent, tin 10 per cent and zinc 2 per cent is the only bronze mixture which lends itself readily to the process. I have melted this mixture in the cupola for use in propellers and tube liners, some of the latter being 20 feet long. When melting the metal in the cupola I always used a mild blast. I had an experience some years ago which convinced me that too mild a blast is just as dangerous as a blast which is too strong. I allowed a foundryman the use of my cupola to melt gun metal for a long liner. He used a mild blast, so mild in fact that I became alarmed as time went on and no sign of the metal appeared. I went over to examine the cupola and found that the metal was practically freezing. I increased the blast and managed to get the metal melted and tapped out but it was not hot enough to pour a casting and had to be poured in a pig bed. We melted the metal again next day with the proper amount of blast and had results which were satisfactory. Upon another occasion I received an order for a manganese bronze propeller. with the order came 10 tons of metal in ingots. The propeller was urgently needed and against my better judgment I decided to try melting the metal in the cupola. The experiment was not a success. The fumes came through the charging door in such volumes that the men could not approach it to finish charging. We had to tap what was melted and drop the bottom. The loss through volatilization was quite heavy. I then built an air furnace similar to that shown in the accompanying illustration. The entire charge was placed in this furnace and melted down. It was delivered into a super-heated ladle at one tap and the propeller poured in a satisfactory manner. The air furnace at present is always used for brass and bronze castings. The percentage of loss is not so great as in cupola melting,

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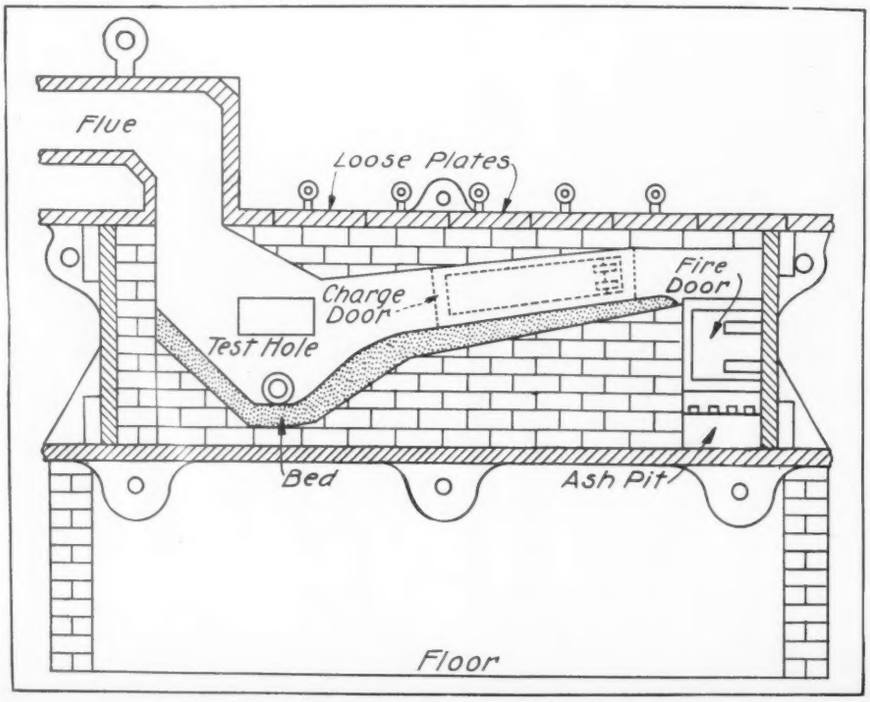



AIR FURNACE FOR MELTING NONFERROUS METALS

# How and Why in Brass Founding

By Charles Vickers

## Core Sand Mixture for Brass Castings

*We would like to obtain a core sand mixture that will permit of eliminating the use of core wash or blacking. At present we are using a mixture of 20 parts sharp sand; 20 parts burnt core sand and 20 parts of molding sand, with dextrine as a binder. The metal appears to eat into the cores.*

If there is a considerable thickness of metal around the cores it will not be possible to get smooth cavities unless the cores are coated with plumbago. In the case of phosphor bronze and a metal thickness over 1 inch, it is necessary to apply the plumbago by rubbing it upon the core. The plumbago is made into a paste with molasses water.

The following mixture will produce a smooth surface on ordinary, thin castings: Dry molding sand, 5 pounds; lake sand, 7 pounds, and linseed oil core compound, 6 ounces by weight. Mix the oil with the sand and apply water to bring the mixture to the proper temper for making cores. Probably if the mixture you are using is sprayed with molasses water before the cores are placed in the oven, it will harden the surface and produce smoother castings.

## Metal Mold for Cross Head Guide

*We would like to get some suggestions in regard to the best method of casting gibbs on locomotive crossheads, and also a mixture suitable for the same. We cast the bronze onto the shoe, the latter being 26 inches long, 7 inches wide, and 1½ inches deep. The thickness of metal is ½ inch on the face and from ¼ to ⅜ on the sides. We are casting them by means of a chill which we clamp to the crosshead shoe, and which is warmed and stood upright on an asbestos base, the metal being poured at the top, like babbitting a bearing.*

If the method of casting these gibbs in a metal mold gives good results, there is no better way of doing this work, and as no mention is made of difficulties encountered, we regard it is quite an achievement. Usually such methods cause the castings to split or to fill with gas holes, and at times both difficulties together are encountered. Blowing and cracking from the shoe can be prevented by getting latter red hot before the metal is poured. This expands it and the bronze and shoe cool together. If the mold blows, the remedy is to use a sand mold or core. This core must not be made in the ordinary foundry manner. It must be bonded with silicate soda, so that it will not burn when in contact with the hot shoe. Such a mold should last several casts, when there are no undercut parts to tear it to pieces. A suitable alloy for this class of casting would be the following: Copper, 80 per cent; tin, 10 per cent, and lead, 10 per cent.

## Core-Sand Mixtures for Aluminum Castings

*We wish to get a mixture suitable for cores for aluminum castings and also information as to the temperature at which they should be baked, and how long. Should an oven be equipped with a pyrometer? We are making aluminum valves and desire a core that can be removed by tumbling. Also is it advisable to use unriddled sand on patterns to be cast of aluminum bronze or brass bushings which are machined.*

For cores for aluminum castings a dextrin binder is satisfactory when used in the proportion of one part dextrin to 25 parts of mixed sand. The mixed sand consists of 3 parts core sand and 1 part molding sand, and if a strong core is desired, 1 part of dextrin can be used to 15 parts of the mixed sand. For aluminum the cores should be as weak as is consistent with sufficient strength to withstand handling. A baking temperature of 350 degrees Fahr. should be employed. A pyrometer on a core oven is a refinement that is useful but it is possible to get along without them. It is never advisable to remove a core from a casting by tumbling. The simplest way of removing a core from a small casting is to affix a steel rod firmly to a bench by one end, have the other end pointed, and insert this point into one end of the core, and rap the bar in the same way as adopted in loosening a pattern in a mold. This will quickly remove the core. It is never advisable to use unriddled sand on any pattern, no matter what metal is used in the casting. Always screen sand on patterns, and the finer the screen the better it is.

## Cast Aluminum to Withstand High Pressure

*We have a number of aluminum water tanks to make and have experienced some little difficulty in getting them water tight.*

Some makers of aluminum vessels, intended to withstand pressures, claim to have been successful in obviating leakage by using sal-ammoniac as a flux on the molten aluminum just before removing it from the furnace and it would be advisable to try this before making changes in the composition of the alloy. No. 12 aluminum is a good alloy to use for most purposes, and is not subject to casting difficulties. An alloy of zinc, 20 per cent and aluminum, 80 per cent might be tried if a zinc-aluminum alloy is being used at present. Carefully note the temperature of the alloy and do not pour it into the molds any hotter than necessary to run the castings. If the aluminum is poured at a red heat, unless it immediately solidifies, the castings will be porous and will leak at extremely low pressures. In using sal-ammoniac, add about a tablespoonful to a pot of aluminum while the metal is in the furnace then stir; when fumes no longer rise, remove the metal for pouring. Chloride of zinc also can be used as a flux. Add a piece the size of a hazel nut to a No. 40 pot of aluminum.

## Sands for Brass Castings

*We use No. 00 Albany sand and whenever we make castings of any weight the sand cuts. At the present time we are making some disks 18 inches in diameter which weigh about 60 pounds. We do not ram the molds hard and we give them a good venting. Nevertheless the sand cuts. We now have some heavier pieces to make, from 200 to 300 pounds and would appreciate any information you could give us on how to overcome the difficulty. We would also like to get a mixture for a valve which has to stand a pressure of 3500 pounds. We are using at present 90 pounds copper and 10 tin but would like to get a cheaper mixture.*

You are probably working your sand too wet. There are two reasons for sand cutting. One is when the sand has not sufficient bond to withstand the friction of the metal flowing over it;

the other is when the heat of the metal develops more steam than the sand can carry away. In the second case some of the steam works toward the face of the mold. This face is already covered by metal and baked by the heat so that the pores in the sand are closed up. The steam is blocked on that side until it gains enough pressure to lift whole pieces of skin off in the shape of blisters and what is known as cutting or scabbing results. There is no lack of bond in Albany No. 00 so your trouble is due to the second cause. Get a coarser grade of sand or mix some sharp sand with your present supply in the proportion of 1 to 10 and use it for facing. Work the sand as dry as possible especially in the drag.

A suitable mixture for a valve which has to stand a pressure of 3500 pounds is: Copper, 80 per cent; tin, 10 per cent; zinc, 5 per cent, and lead, 5 per cent. The greatest care must be exercised in melting metal for hydraulic work. In addition to the usual charcoal covering you had better throw a handful of salt over the charge in the crucible and after the pot has been lifted out a further precaution would be to add about ¼ pound of phosphor-copper for each 100 pounds of metal.

It is not necessary to use all new metal. From 20 to 30 per cent scrap may be added to the mixture provided care is exercised in the selection and the analysis is adhered to.

## Type Metal Mixtures

*We would like to obtain information regarding the composition of type metal used in linotype machines and also that employed for making stereotype plates.*

The compositions of these alloys vary considerably. The following formulas are all termed stereotype metals:

| No. | Lead, Per Cent | Tin, Per Cent | Antimony, Per Cent |
|---|---|---|---|
| 1 | 68 | 14 | 18 |
| 2 | 35 | 60 | 5 |
| 3 | 82 | 6 | 12 |
| 4 | 82 | 3.2 | 14.8 |
| 5 | 70 | 13 | 17 |

Alloy No. 5 is known as Mackenzie metal. What is termed *Standard* stereotype metal consists of lead, 82.5 per cent; tin, 4.5 per cent, and antimony, 13 per cent. This alloy is similar to the anti-friction mixture known as *magnolia* metal. Standard linotype metal consists of lead, 83 per cent; tin, 5 per cent, and antimony, 12 per cent. Another linotype metal contains less tin than the *Standard*, the mixture consisting of lead, 85 per cent; tin, 3 per cent, and antimony, 12 per cent. It will be noted that some of these alloys contain a considerable percentage of tin and it is obvious that the higher the tin percentage, the more costly the alloy.

## High Temperature Resisting Lubricant

*We would like to obtain information relative to a high melting point mixture of graphite and composition for insertion into bushings. The mixture must not melt under 140 degrees of heat.*

For lubricating purposes graphite is mixed with oils and greases. General experience shows that a mineral oil that will evaporate more than 5 per cent at 140 degrees Fahr. is unsafe, as it either evaporates and leaves the bearing dry, or it forms a viscid residue that causes friction. A graphite lubricant extensively used consists of tallow 100 parts and powdered graphite 100 parts, well mixed. If this mixture melts too easily its melting point can be increased by the addition of wax to the tallow. The waxes to use are paraffin or ozokerits wax. Rosin also can be added to increase the melting point of the mixture.

## Difficulties With Aluminum Ingots

*We are sending for your inspection two samples of ingot aluminum which have given poor results in our foundry, and we would like to have your opinion in regard to their quality and suitability for alloying to produce commercial castings of aluminum. It is our opinion that the larger sample containing two notched sections contains iron or some other foreign substance. This aluminum was bought for 98 per cent pure aluminum. The small sample it would appear to us, is a poor grade of No. 12 aluminum. In using the "pure" aluminum we first made a hardener of 50 per cent copper and 50 per cent aluminum, and added 16 pounds of this hardener to 84 pounds of the aluminum. The castings from this mixture all cracked. We then diminished the content of hardener and used only 8 per cent hardener to 92 per cent aluminum with the same result. Any information you may be able to give us will be greatly appreciated.*

We suggest that a quantitative analysis be made of the two samples of aluminum, as this is the only certain means of knowing just what they contain, and when this knowledge is at hand the problem of the suitability of the aluminum for casting purposes is solved. A qualitative analysis, however, indicates that the "98 per cent pure" aluminum contains considerable iron; entirely too much for casting purposes; also zinc, but little copper. The small sample is not No. 12 alloy at all, as this grade of aluminum should contain copper as the hardening agent but the sample contains much iron and zinc and very little copper. An analysis will determine just what these proportions are, and will enable the material to be used to the best advantage. An inspection of the ingots shows them to have been carelessly made as pieces of iron ore are embedded in the bottoms of the notches. This iron ore will not improve the aluminum, and while the heat of melting may be not sufficiently high to produce a reaction between the iron oxide and the aluminum with reduction of iron which adds still further to the iron content of the aluminum it is not advisable to take the chance because it is so unnecessary. It would appear that the iron oxide is being used as a flux in melting the aluminum, and some of it ran into the ingots with the aluminum and being heavier had settled to the bottom. It seems hardly possible that ingots would be poured into molds partly filled with dirt. The iron ore is probably used in other refining operations connected with the production of the heavier metals. If it is possible to get some commercially pure aluminum, then this might be used to dilute the present supply and so get good castings, but as the material stands it will be costly to attempt to cast it.

## Batteries for Fluxing

*We would like to know the value of a dry cell battery as a flux for brass and bronze, also if the chemicals contained therein cannot be bought at a reasonable price and be mixed substantially the same as in a used battery? Any information regarding the best manner of making such a flux for use on brass and bronze will be appreciated.*

The composition of the paste used in dry cells is liable to considerable variation, but the majority of the cells extensively used contain charcoal, oxide of manganese, sal ammoniac, zinc chloride, plaster of paris and flour. Used as a flux on brass the sal ammoniac and zinc chloride give off fumes which exclude the furnace gases. The flour, of course burns to charcoal, the plaster of paris is a good covering, and the charcoal and the manganese oxide react as the metal melts and some manganese is reduced and enters the brass and deoxidizes the same to some extent. If too much flux in the shape of batteries is used on the brass or bronze, the castings will come from the sand a brownish color, showing that too much manganese has entered the alloy. The flux can be imitated as far as results are concerned by mixing about 10 per cent manganese oxide with charcoal and adding a little common salt, borax and sand.

## LENGTH OF CHORDS FOR SPACING CIRCLES

*By W. L. Tryon*

*(Continued from Data Sheet No. 294)*

| No. of Spaces | Length of Chord When Diameter is 1 ft. | 2 ft. | 3 ft. | 4 ft. | 5 ft. | 6 ft. | 7 ft. | 8 ft. | 9 ft. | 10 ft. |
|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 1.4464 | 2.8929 | 4.3393 | 5.7858 | 7.2322 | 8.6785 | 10.1250 | 11.5714 | 13.0179 | 14.4643 |
| 27 | 1.3931 | 2.7862 | 4.1793 | 5.5725 | 6.9656 | 8.3587 | 9.7518 | 11.1449 | 12.5380 | 13.9311 |
| 28 | 1.3435 | 2.6871 | 4.0307 | 5.3743 | 6.7179 | 8.0614 | 9.4050 | 10.7486 | 12.0922 | 13.4357 |
| 29 | 1.2974 | 2.5949 | 3.8923 | 5.1897 | 6.4871 | 7.7846 | 9.0820 | 10.3794 | 11.6768 | 12.9742 |
| 30 | 1.2543 | 2.5087 | 3.7630 | 5.0174 | 6.2717 | 7.5260 | 8.7804 | 10.0347 | 11.2891 | 12.5434 |
| 31 | 1.2140 | 2.4280 | 3.6421 | 4.8561 | 6.0701 | 7.2841 | 8.4981 | 9.7122 | 10.9262 | 12.1402 |
| 32 | 1.1762 | 2.3524 | 3.5286 | 4.7048 | 5.8810 | 7.0572 | 8.2334 | 9.4096 | 10.5858 | 11.7621 |
| 33 | 1.1407 | 2.2813 | 3.4220 | 4.5627 | 5.7034 | 6.8440 | 7.9847 | 9.1254 | 10.0660 | 11.4067 |
| 34 | 1.1072 | 2.2144 | 3.3217 | 4.4289 | 5.5361 | 6.6433 | 7.7505 | 8.8578 | 9.9650 | 11.0722 |
| 35 | 1.0757 | 2.1513 | 3.2270 | 4.3027 | 5.3784 | 6.4540 | 7.5297 | 8.6054 | 9.6810 | 10.7567 |
| 36 | 1.0459 | 2.0917 | 3.1376 | 4.1835 | 5.2293 | 6.2752 | 7.3211 | 8.3669 | 9.4128 | 10.4587 |
| 37 | 1.0177 | 2.0353 | 3.0530 | 4.0707 | 5.0883 | 6.1060 | 7.1237 | 8.1414 | 9.1590 | 10.1767 |
| 38 | .9910 | 1.9819 | 2.9729 | 3.9638 | 4.9548 | 5.9457 | 6.9367 | 7.9276 | 8.9186 | 9.9095 |
| 39 | .9656 | 1.9312 | 2.8968 | 3.8624 | 4.8280 | 5.7936 | 6.7592 | 7.7248 | 8.6904 | 9.6560 |
| 40 | .9415 | 1.8830 | 2.8245 | 3.7660 | 4.7075 | 5.6491 | 6.5906 | 7.5321 | 8.4736 | 9.4151 |
| 41 | .9186 | 1.8372 | 2.7558 | 3.6744 | 4.5930 | 5.5115 | 6.4301 | 7.3487 | 8.2073 | 9.1859 |

| No. of Spaces | Length of Chord When Diameter is 1 in. | 2 in. | 3 in. | 4 in. | 5 in. | 6 in. | 7 in. | 8 in. | 9 in. | 10 in. | 11 in. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | .1205 | .2411 | .3616 | .4821 | .6027 | .7232 | .8438 | .9643 | 1.0848 | 1.2054 | 1.3259 |
| 27 | .1161 | .2322 | .3483 | .4644 | .5805 | .6966 | .8127 | .9287 | 1.0448 | 1.1609 | 1.2770 |
| 28 | .1120 | .2239 | .3359 | .4480 | .5598 | .6718 | .7838 | .8957 | 1.0077 | 1.1196 | 1.2316 |
| 29 | .1081 | .2162 | .3244 | .4324 | .5406 | .6487 | .7568 | .8650 | .9731 | 1.0812 | 1.1893 |
| 30 | .1045 | .2091 | .3136 | .4181 | .5226 | .6272 | .7317 | .8362 | .9408 | 1.0453 | 1.1498 |
| 31 | .1012 | .2023 | .3035 | .4047 | .5058 | .6070 | .7082 | .8093 | .9105 | 1.0117 | 1.1129 |
| 32 | .0980 | .1960 | .2941 | .3921 | .4901 | .5881 | .6861 | .7841 | .8822 | .9802 | 1.0782 |
| 33 | .0951 | .1901 | .2852 | .3802 | .4753 | .5703 | .6654 | .7604 | .8555 | .9506 | 1.0456 |
| 34 | .0923 | .1845 | .2768 | .3691 | .4613 | .5536 | .6459 | .7381 | .8304 | .9227 | 1.0150 |
| 35 | .0896 | .1793 | .2689 | .3586 | .4482 | .5378 | .6275 | .7171 | .8068 | .8964 | .9860 |
| 36 | .0872 | .1743 | .2615 | .3486 | .4358 | .5229 | .6101 | .6972 | .7844 | .8716 | .9587 |
| 37 | .0848 | .1696 | .2544 | .3392 | .4240 | .5088 | .5936 | .6784 | .7633 | .8481 | .9329 |
| 38 | .0826 | .1651 | .2477 | .3303 | .4129 | .4955 | .5781 | .6606 | .7432 | .8258 | .9084 |
| 39 | .0805 | .1609 | .2414 | .3219 | .4023 | .4828 | .5633 | .6437 | .7242 | .8047 | .8851 |
| 40 | .0785 | .1569 | .2354 | .3138 | .3923 | .4708 | .5492 | .6277 | .7061 | .7846 | .8631 |
| 41 | .0765 | .1531 | .2296 | .3062 | .3827 | .4593 | .5358 | .6124 | .6889 | .7655 | .8420 |

| No. of Spaces | Length of Chord to be Added for Each Additional Fraction of ⅛ in. | ¼ in. | ⅜ in. | ½ in. | ⅝ in. | ¾ in. | ⅞ in. |
|---|---|---|---|---|---|---|---|
| 26 | .0151 | .0301 | .0452 | .0603 | .0753 | .0904 | .1055 |
| 27 | .0144 | .0288 | .0432 | .0575 | .0719 | .0863 | .1007 |
| 28 | .0140 | .0280 | .0420 | .0560 | .0700 | .0840 | .0980 |
| 29 | .0135 | .0270 | .0405 | .0541 | .0676 | .0811 | .0946 |
| 30 | .0131 | .0261 | .0392 | .0523 | .0653 | .0784 | .0915 |
| 31 | .0126 | .0253 | .0379 | .0506 | .0632 | .0759 | .0885 |
| 32 | .0123 | .0245 | .0368 | .0490 | .0613 | .0735 | .0858 |
| 33 | .0119 | .0238 | .0356 | .0475 | .0594 | .0713 | .0832 |

| No. of Spaces | Length of Chord to be Added for Each Additional Fraction of ⅛ in. | ¼ in. | ⅜ in. | ½ in. | ⅝ in. | ¾ in. | ⅞ in. |
|---|---|---|---|---|---|---|---|
| 34 | .0115 | .0231 | .0346 | .0461 | .0577 | .0692 | .0807 |
| 35 | .0112 | .0224 | .0336 | .0448 | .0560 | .0672 | .0784 |
| 36 | .0109 | .0218 | .0327 | .0436 | .0545 | .0654 | .0763 |
| 37 | .0106 | .0212 | .0318 | .0424 | .0532 | .0636 | .0742 |
| 38 | .0103 | .0206 | .0310 | .0413 | .0516 | .0619 | .0723 |
| 39 | .0101 | .0201 | .0302 | .0402 | .0503 | .0603 | .0704 |
| 40 | .0098 | .0196 | .0294 | .0392 | .0490 | .0588 | .0687 |
| 41 | .0096 | .0191 | .0287 | .0383 | .0478 | .0574 | .0670 |

*(Continued on Data Sheet No. 296)*



## LENGTH OF CHORDS FOR SPACING CIRCLES

*By W. L. Tryon*

*(Continued from Data Sheet No. 295*

| No. of Spaces | Length of Chord When Diameter is 1 ft. | 2 ft. | 3 ft. | 4 ft. | 5 ft. | 6 ft. | 7 ft. | 8 ft. | 9 ft. | 10 ft. |
|---|---|---|---|---|---|---|---|---|---|---|
| 42 | .8968 | 1.7935 | 2.6903 | 3.5870 | 4.4838 | 5.3806 | 6.2773 | 7.1741 | 8.0709 | 8.9676 |
| 43 | .8759 | 1.7519 | 2.6278 | 3.5038 | 4.3797 | 5.2557 | 6.1316 | 7.0075 | 7.8835 | 8.7594 |
| 44 | .8561 | 1.7121 | 2.5682 | 3.4243 | 4.2803 | 5.1364 | 5.9925 | 6.8486 | 7.7046 | 8.5607 |
| 45 | .8371 | 1.6742 | 2.5112 | 3.3483 | 4.1854 | 5.0225 | 5.8595 | 6.6966 | 7.5337 | 8.3708 |
| 46 | .8189 | 1.6378 | 2.4567 | 3.2756 | 4.0945 | 4.9134 | 5.7324 | 6.5513 | 7.3702 | 8.1891 |
| 47 | .8015 | 1.6030 | 2.4045 | 3.2060 | 4.0076 | 4.8091 | 5.6106 | 6.4121 | 7.2136 | 8.0151 |
| 48 | .7848 | 1.5697 | 2.3545 | 3.1393 | 3.9242 | 4.7090 | 5.4939 | 6.2787 | 7.0635 | 7.8484 |
| 49 | .7688 | 1.5377 | 2.3065 | 3.0754 | 3.8442 | 4.6131 | 5.3819 | 6.1507 | 6.9196 | 7.6884 |
| 50 | .7535 | 1.5070 | 2.2605 | 3.0139 | 3.7674 | 4.5209 | 5.2744 | 6.0279 | 6.7814 | 7.5349 |
| 51 | .7387 | 1.4774 | 2.2162 | 2.9549 | 3.6937 | 4.4324 | 5.1711 | 5.9098 | 6.6486 | 7.3873 |
| 52 | .7245 | 1.4491 | 2.1736 | 2.8982 | 3.6227 | 4.3472 | 5.0718 | 5.7963 | 6.5209 | 7.2454 |
| 53 | .7109 | 1.4218 | 2.1327 | 2.8435 | 3.5544 | 4.2653 | 4.9762 | 5.6871 | 6.3980 | 7.1089 |
| 54 | .6977 | 1.3955 | 2.0932 | 2.7910 | 3.4887 | 4.1864 | 4.8842 | 5.5819 | 6.2796 | 6.9774 |
| 55 | .6851 | 1.3701 | 2.0552 | 2.7403 | 3.4253 | 4.1104 | 4.7955 | 5.4805 | 6.1656 | 6.8507 |
| 56 | .6728 | 1.3457 | 2.0185 | 2.6914 | 3.3642 | 4.0731 | 4.7099 | 5.3828 | 6.0556 | 6.7284 |
| 57 | .6611 | 1.3221 | 1.9382 | 2.6442 | 3.3053 | 3.9663 | 4.6274 | 5.2884 | 5.9495 | 6.6105 |

| No. of Spaces | Length of Chord When Diameter is 1 in. | 2 in. | 3 in. | 4 in. | 5 in. | 6 in. | 7 in. | 8 in. | 9 in. | 10 in. | 11 in. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 42 | .0747 | .1495 | .2242 | .2989 | .3736 | .4484 | .5231 | .5978 | .6726 | .7473 | .8220 |
| 43 | .0730 | .1460 | .2190 | .2920 | .3650 | .4380 | .5110 | .5840 | .6570 | .7300 | .8029 |
| 44 | .0713 | .1427 | .2140 | .2854 | .3567 | .4280 | .4993 | .5707 | .6421 | .7134 | .7847 |
| 45 | .0698 | .1395 | .2093 | .2790 | .3488 | .4185 | .4883 | .5581 | .6278 | .6976 | .7673 |
| 46 | .0682 | .1365 | .2047 | .2730 | .3412 | .4095 | .4777 | .5459 | .6142 | .6824 | .7507 |
| 47 | .0668 | .1336 | .2004 | .2672 | .3340 | .4008 | .4675 | .5343 | .6011 | .6679 | .7347 |
| 48 | .0654 | .1308 | .1962 | .2616 | .3270 | .3924 | .4578 | .5232 | .5886 | .6540 | .7194 |
| 49 | .0641 | .1281 | .1922 | .2563 | .3204 | .3844 | .4485 | .5126 | .5766 | .6407 | .7048 |
| 50 | .0628 | .1256 | .1884 | .2512 | .3140 | .3767 | .4395 | .5023 | .5651 | .6279 | .6907 |
| 51 | .0616 | .1231 | .1847 | .2462 | .3078 | .3694 | .4309 | .4925 | .5540 | .6156 | .6772 |
| 52 | .0604 | .1208 | .1811 | .2415 | .3019 | .3623 | .4226 | .4830 | .5434 | .6038 | .6642 |
| 53 | .0592 | .1184 | .1777 | .2370 | .2962 | .3554 | .4147 | .4739 | .5332 | .5924 | .6516 |
| 54 | .0581 | .1163 | .1744 | .2326 | .2907 | .3489 | .4070 | .4652 | .5233 | .5814 | .6396 |
| 55 | .0571 | .1142 | .1713 | .2284 | .2854 | .3425 | .3996 | .4567 | .5138 | .5709 | .6280 |
| 56 | .0561 | .1121 | .1682 | .2243 | .2804 | .3364 | .3925 | .4486 | .5046 | .5607 | .6168 |
| 57 | .0551 | .1102 | .1653 | .2204 | .2754 | .3305 | .3856 | .4407 | .4958 | .5509 | .6060 |

| No. of Spaces | Length of Chord to be Added for Each Additional Fraction of ⅛ in. | ¼ in. | ⅜ in. | ½ in. | ⅝ in. | ¾ in. | ⅞ in. |
|---|---|---|---|---|---|---|---|
| 42 | .0093 | .0187 | .0280 | .0374 | .0467 | .0560 | .0654 |
| 43 | .0091 | .0182 | .0274 | .0365 | .0456 | .0547 | .0639 |
| 44 | .0089 | .0178 | .0268 | .0357 | .0446 | .0535 | .0624 |
| 45 | .0087 | .0174 | .0262 | .0349 | .0436 | .0523 | .0610 |
| 46 | .0085 | .0171 | .0256 | .0341 | .0427 | .0512 | .0597 |
| 47 | .0083 | .0167 | .0250 | .0334 | .0417 | .0501 | .0584 |
| 48 | .0082 | .0164 | .0245 | .0327 | .0409 | .0491 | .0572 |
| 49 | .0080 | .0160 | .0240 | .0320 | .0400 | .0481 | .0561 |

| No. of Spaces | Length of Chord to be Added for Each Additional Fraction of ⅛ in. | ¼ in. | ⅜ in. | ½ in. | ⅝ in. | ¾ in. | ⅞ in. |
|---|---|---|---|---|---|---|---|
| 50 | .0078 | .0157 | .0235 | .0314 | .0392 | .0471 | .0549 |
| 51 | .0077 | .0154 | .0231 | .0308 | .0385 | .0462 | .0539 |
| 52 | .0075 | .0151 | .0226 | .0302 | .0377 | .0453 | .0528 |
| 53 | .0074 | .0148 | .0222 | .0296 | .0370 | .0444 | .0518 |
| 54 | .0073 | .0145 | .0218 | .0291 | .0363 | .0436 | .0509 |
| 55 | .0071 | .0143 | .0214 | .0285 | .0357 | .0428 | .0500 |
| 56 | .0070 | .0140 | .0210 | .0280 | .0350 | .0421 | .0491 |
| 57 | .0069 | .0138 | .0207 | .0275 | .0344 | .0413 | .0482 |



THE FOUNDRY DATA SHEET, AUGUST 1, 1919
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

# Castings for Ship Construction—VII

## Extreme Accuracy Is Necessary in Laying Out and Building Patterns for Propeller Brackets—Because of Shape of Casting, Unusual Precautions to Allow for Shrinkage Must Be Taken

By BEN SHAW and JAMES EDGAR

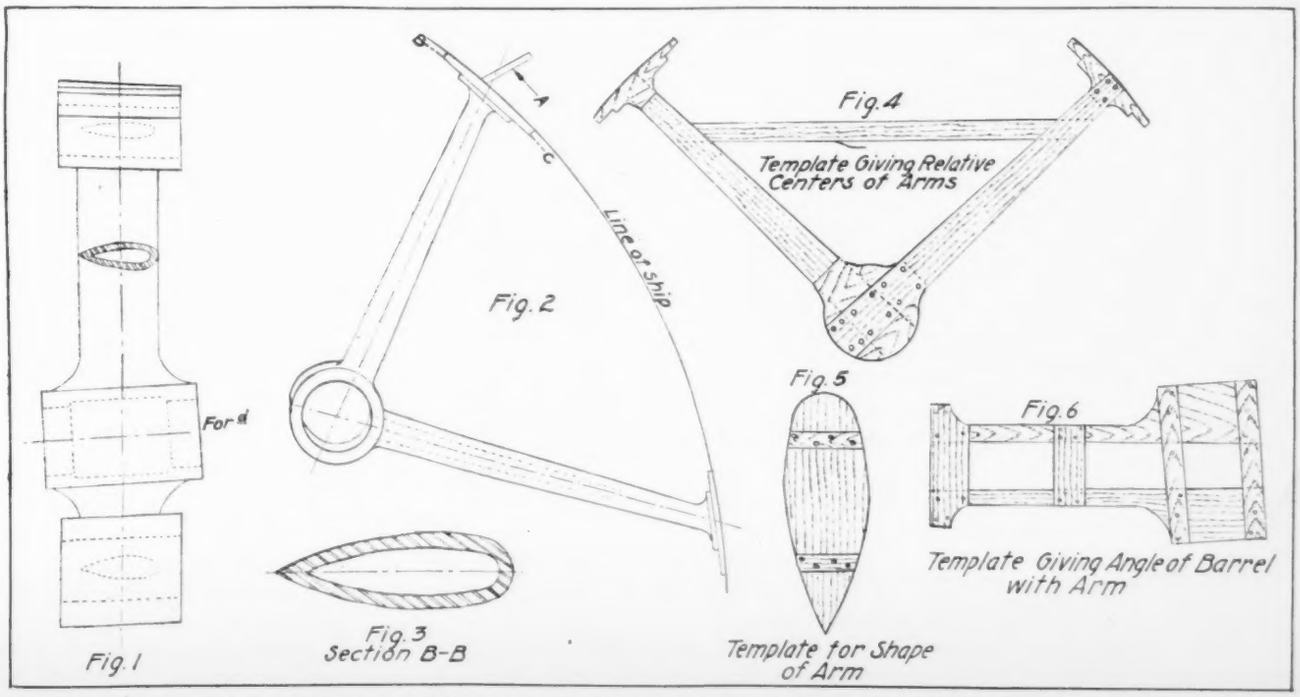
IN making a propeller shaft bracket unusual care must be exercised to insure accuracy so that when fastened to the ship, the casting fits the frame and the shaft boss is in its proper position. There is no single standard type of bracket casting, but many modifications or variations of three or four different kinds are in common use. Apart from the design, which depends upon whether the ship is single screw or twin screw, some brackets are designed with palms to rivet on the outer skin, while the arms of others pass through the outer plates, and are fixed to an inner shell or to special angle plates. Others sit on a special platform or foot which is cast upon and is a unit with the stern-frame.

It used to be the practice to make all propeller brackets in gun metal because of its toughness, but such castings were very costly and as steel founding developed, it was natural that steel should replace it.

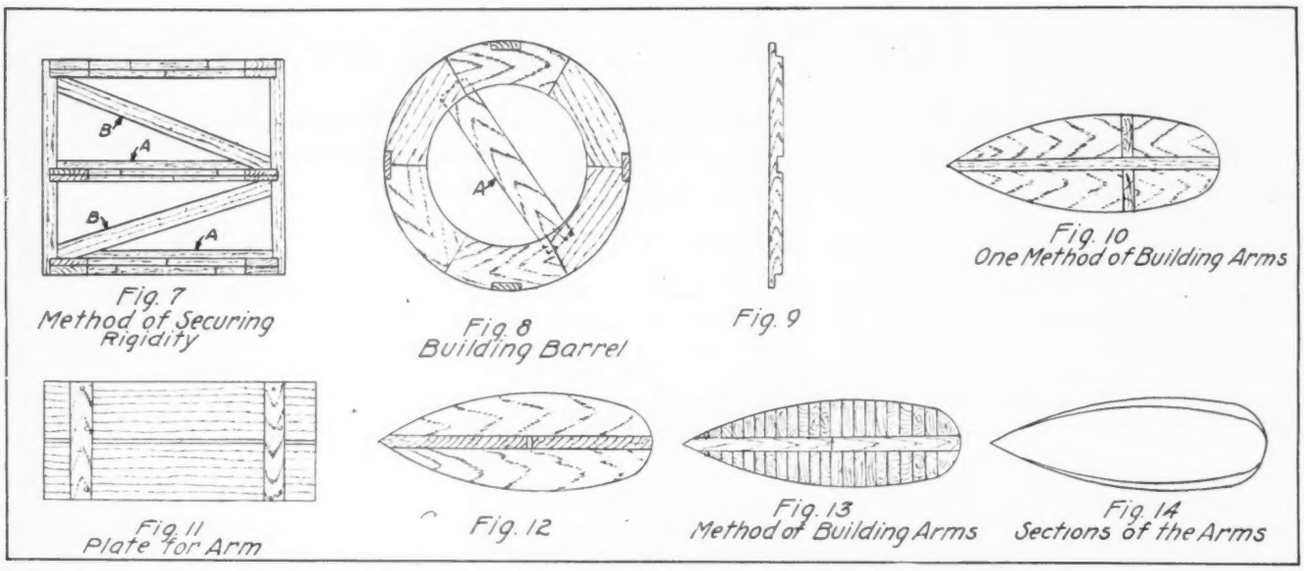
It is always an advantage with bracket patterns to build them as they would be in the ship. All sizes on the drawing are usually given from a datum or water line, and although the pattern-maker works principally from templates, the drawing always has to be at hand for reference, and to read measurements for details which cannot be given on the templates. Building the pattern according to the position of the casting in the ship also simplifies and makes more sure the work of the checker. However, it is not always possible to do this and sometimes as an alternative, after the pattern is finished, it is lifted into the ship position to be tested. The design is important. The bracket which is explained in this article can be made and checked very conveniently with the barrel in a perpendicular position or approximately so. It is readily seen by looking at Figs. 1 and 2 that it is awkward to build it with the barrel resting horizontally on the floor, or at an angle corresponding to the rake of the shaft. The arms or fishbacks, as they are frequently termed, can be fitted accurately, but the proper way to make circled palms such as those in this bracket, is to make mocks representing the contour or shell of the ship and fix the palms to them. It is inconvenient, if not impossible, to build a mock to the top arm.

The arms of the brackets shown are cored out. This is occasionally done although it is not common practice. The only outlet for the core is through the boss, and it is not necessary for the patternmaker to make prints or arrange at all for setting the core which will be laid on chaplets. A core box will have to be made.

Before describing the various constructive operations it may be well to glance at the working drawings, Figs. 1, 2 and 3, and compare them with the plan of the finished pattern, Fig. 30. The pattern consists of a barrel for the boss, with fillets for the arms fitted to it; and the arms themselves, which are held in their correct position by means of dovetails; and the circled palms which are in like manner dovetailed to the arms. As in the case of other steel castings templates are supplied by the carpenters of the molding loft, or patternmakers go there and make their own templates. For this job two templates are absolutely necessary, and invariably one for the arm, shown in Fig. 6, also is made. The timber need only be ¼-inch thick and can be nailed. Fig. 5 shows a template through the center of the arms and Fig. 4 illustrates a template determining the angle of the center line of the boss, and of the palms in relation to the center lines of the arms. Great care must be taken in




FIGS. 1, 2 AND 3—WORKING DRAWING OF COMMON TYPE OF PROPELLER SHAFT BRACKET FIG. 4—TEMPLATE SHOWING RELATIVE CENTERS OF ARMS FIG. 5—TEMPLATE FOR SHAPE OF ARMS FIG. 6—TEMPLATE SHOWING ANGLE OF BARREL WITH ARMS




FIGS. 7, 8 AND 9—METHOD OF BUILDING BARREL, SHOWING ARRANGEMENT OF STAVES, TO INSURE RIGIDITY FIGS. 10, 11, 12, 13 AND 14—VARIOUS MEMBERS OF CONSTRUCTING ARMS

using the former template, as it is used when setting out the shape of the work on the building floor, and it is not a section on the floor level. The angle of the arms is correct, but the outer faces and the boss are correct only at the center of the arms. It is well to compare the template carefully with the drawing, and differences in angles or sizes can be allowed for in building. In setting out the work on the floor, the cross center lines of the boss, both at the top and the bottom, should be drawn as they are shown on the drawing, this enabling plumblines to be afterwards dropped from the top of the barrel to make sure that it is lying at the correct angle. It is not sufficient simply to make the angle given by template. The arms of these castings when cooling and contracting generally spread further apart and it is advisable, unless the foundry's practice is well known, to ascertain whether a special allowance will have to be made on the pattern. Much depends on the foundry and on the characteristics of the metal used. There are foundries from which castings are turned out with the arms at exactly the same angle to each other as the arms of the pattern. In all cases contraction allowance has of course to be left in the length of the arm. Both ends of the boss are machined and usually the faces of the palms. It is as well if the palms are thin to allow from ⅛ to ¼-inch of extra metal on the backs to reinforce them in case of the metal being spongy or porous. In the bore of the boss at least 1 inch in diameter should be left for machining.

The barrels of the pattern should be stoutly made. In addition to the weight of the arms, the barrel is subjected to heavy strains when it is drawn perpendicularly from the mold. If it is lightly constructed the grounds will be pulled away and the lagging left behind. Sometimes as much as ½ inch of taper a side is allowed on the boss, and if the taper is not shown the patternmaker and the molder must decide what is advisable. The chambered core also can be tapered to reduce the weight of the casting. Some foundries prefer to cast a straight bore in the boss and machine the inside clearance out afterwards.

Fig. 19 is a drawing of the finished barrel. Part of it is lagged and part segmentally built, the two parts being dowelled together. It is more convenient for the molder if the barrel is made in two parts, the division being at the widest part of the arm, which forms the molders joint line. The top segmental part will thus be lifted in the cope. The circular rings of the

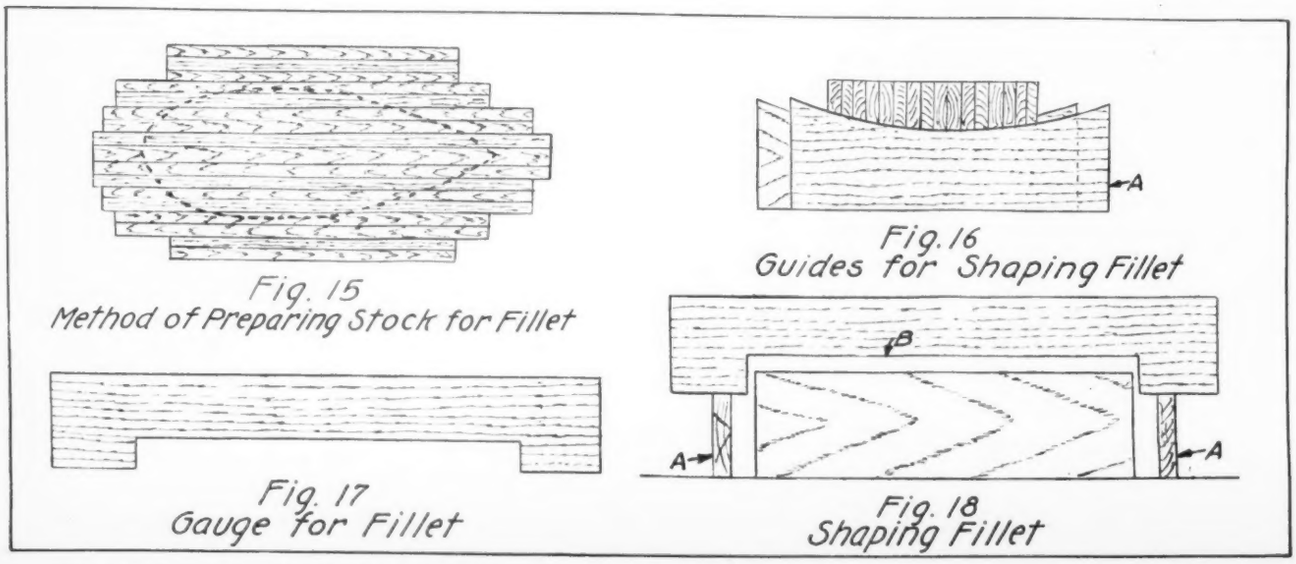



FIG. 15—METHOD OF PREPARING STOCKS FOR FILLET FIG. 16—GUIDE USED FOR SHAPING FILLET FIGS. 17 AND 18—GAGE AND METHOD OF SHAPING FILLET

barrel should be of two laminae of segments, making a thickness of at least 2½ inches and a width of from 4 to 5 inches. The number of rings depend on the length of the barrel and should not be more than 20 inches apart. If they are too wide apart the hard rammed sand will force the narrow staves to yield, and the result will be a casting disappointing in appearance. If the barrel is short and the taper decided upon is not more than ⅛-inch the rings can be screwed together and sandpapered to shape. Four stays similar to that shown in Fig. 9, 2 inches thick and 4 or 4½ inches wide, ought to be made. If the slots for these stays are carefully cut square at the band saw before the rings are separated, there will be no trouble in squaring them when they are screwed in place. Before the stays are fixed to the rings, crossed pieces as shown at *A*, Figs. 7 and 8 should be screwed to the underside of the rings and a 1-inch hole bored in the center. This is to guide and steady the lifting . 't, the tapped plate for which can be s..ewed on the bottom print. When the stays have been screwed to the rings, and the work tested for square, raking stays, *B*, Fig. 7, should be fitted, care being taken that they are clear of the center of the barrel when the latter is built up. For a barrel for ordinary work the lagging need only be ⅞ or 1-inch thick, but for a steel job of this kind, the material should be 1½ or 2 inches thick. It is well to screw the lagging and ⅛-inch space should be left between each stay. Building the segmental portion is a simple operation. The two parts can either be dowelled together or the inside of the top ring may be finished to a true diameter, and a segment of the same diameter screwed to the segmental part, thus making a socket joint. The print on the bottom of the barrel need only be 1 or 1¼ inch thick, as it is merely a guide when setting the core and not a support. It should not be screwed in its place until the whole pattern is completed as it would be in the way when building.

*Constructing Arms of Pattern*

In building the arms it is not advisable, as is sometimes done, to run the timber longitudinally, because of the great amount of labor involved and also because the thin timber will lift and the surface of the casting, will be irregular. The best way of constructing the arms is to make 1½-inch center plates, as shown in Fig. 11, with two cross battens inset to half the thickness, and build on this plate timber that has been disc sandpapered to the correct section. Some prefer to make a cross as shown at Fig. 10 and fill it with corner pieces in preference to the above method which is illustrated in Fig. 13. The advantage of this method is that it makes what may be termed unshrinkable ends for jointing to the boss fillet and the palm. However, it takes longer to build and demands greater care, as there are so many pieces. The arms should be planed after they are built. Another way in which the arms are occasionally made is to joint 1½-inch timber longitudinally on the center plate with the annual rings back-to-back as shown in Fig. 12. If good glue is used and the pattern is painted this makes a beautiful but somewhat expensive job. In practice, cross sections of each end of the arm can be set out, one on top of the other like Fig. 14. The exact shape of each piece is obtained and can be almost finished at the edge planing machine.

The fillets connecting the arms with the boss represent the biggest hand tool job on the pattern. What already has been said about building the arms applies equally to the fillets. The best method is to build them like Fig. 15, and nails or screws should be dispensed with for obvious reasons. Some can be inserted after the fillets are carved. It is well to fit the fillet blocks to the

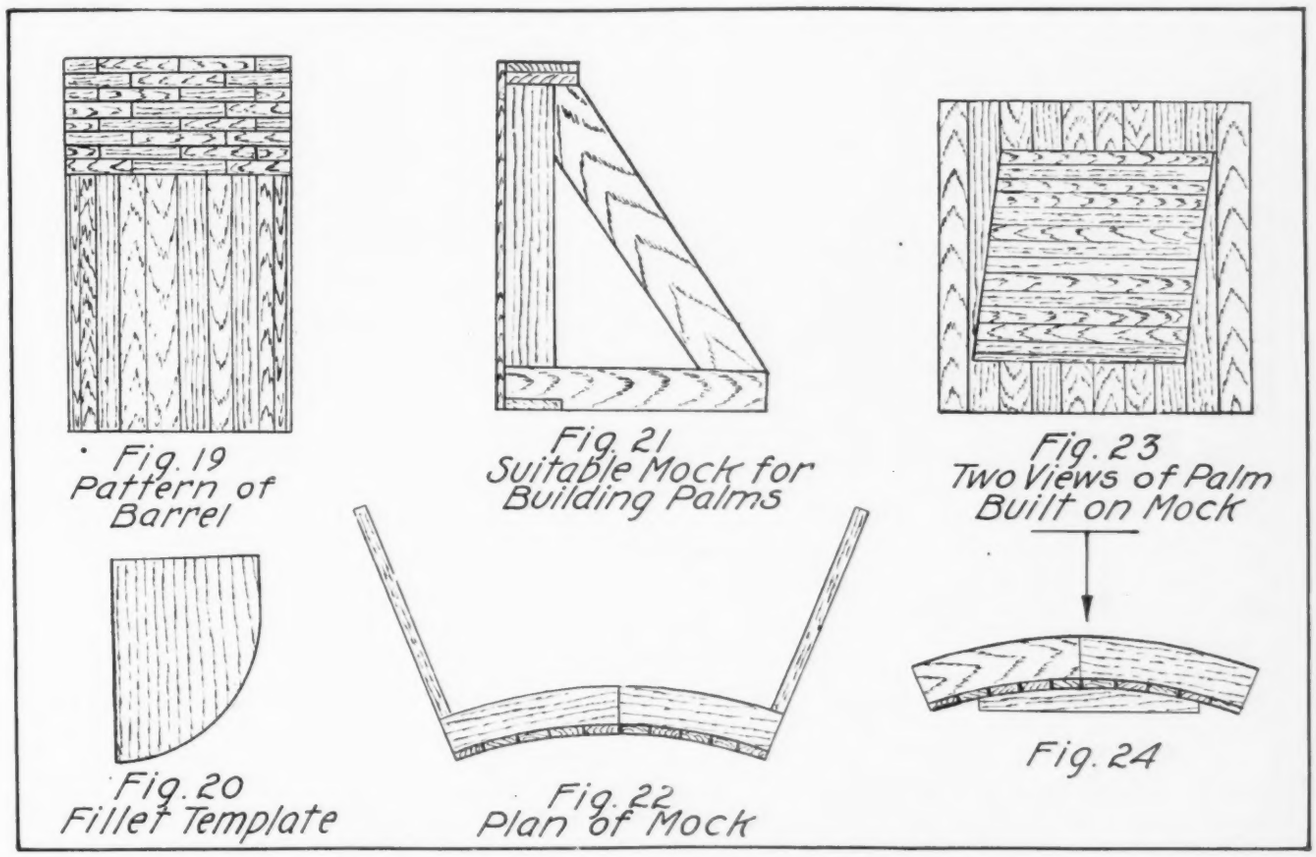



FIG. 19—METHOD OF BUILDING UP PATTERN OF BARREL FIG. 20—TEMPLATE FOR FILLET FIGS. 21 AND 22—TWO VIEWS OF MOCK BUILT TO SUPPORT PALMS FIGS. 23 AND 24—ELEVATION AND PLAN VIEW SHOWING PALM BUILT ON MOCK

barrel and shape them afterwards. Although the full fillet is built at one operation it can be sawed across as part of it will be on the segmental portion of barrel and part on the lagged portion. It is quite possible to saw these built blocks to a regular outer shape, and to project from this shape points which define the line of contact with the barrel, but this is making a fetish of geometrical projection, and takes much longer than the process illustrated in Figs. 16 and 18. Two guides *A* with a radius the same as the barrel are screwed to a bottom plate. As the center line of the barrel is not in the same plane as the center line of the arm, the portion of the guides will have to represent approximately this difference, which accounts for the guides being drawn from different centers in the sketch. Cutting off the surplus timber may be simplified by making the gage, Fig. 17, which is shown in position resting on the end guides in Fig. 18. An accurate cutting line can be drawn by using hermaphrodites, the caliper leg bearing on edge *B* of the gage while the point marks, the gage being moved across at the same time. This is a very useful expedient for general fitting work in the patternshop. When the plane is being used to finish the concave fitting surface a straightedge can be applied on the guides to test the work. The fillet blocks ought to be glued to the barrel and well screwed, and the glue should be thoroughly dry before gouging the shape is begun. Although it may be possible to use two templates similar to Fig. 20 lifted from the drawing, workmen must depend upon sight and touch to make a fine finish. Fig. 30 shows the barrel and fillet.

The palms have still to be made. The projecting flange, *A* Fig. 2, may be ignored meantime. It would not be advisable, even if it were possible, to make the palms of one-thickness timber. They must be built in layers, but it is better instead of building them first and shaping them afterwards to shape each piece as it is made. The only craftsmanlike way of doing this is to construct the mocks and build on them. These mocks should be substantially built, although they are not a part of the pattern. If they are too light, they will be worse than useless when the various parts of the pattern are assembled. Two views of the mock are shown in Figs. 21 and 22 and Fig. 23 shows a front view indicating part of the palm in place. A plan drawing is shown in Fig. 24. It is best to build the mocks in their positions on the floor and not to move them until the whole work is completed. They should be made a few inches bigger each way than the palm. Two triangular frames have to be made for each mock, and it is as well to make the top arc piece of two thicknesses of segments. A single thickness of segment screwed to the floor will do for the bottom. When the frames have been firmly screwed down and the top arc piece is screwed on, 1-inch lagging should be nailed on the face, which completes the mock. The mock completed, the palms may be built. The best job is obtained by making them in two layers crossed on the line *B C*, Fig. 2. The shape should be drawn on the mock and lines corresponding to the line *B C*, Fig. 2, and the ends of the arms, ought to be set down on the floor. Timber about 1½-inch thick should be used for the palms, and each piece should be quite

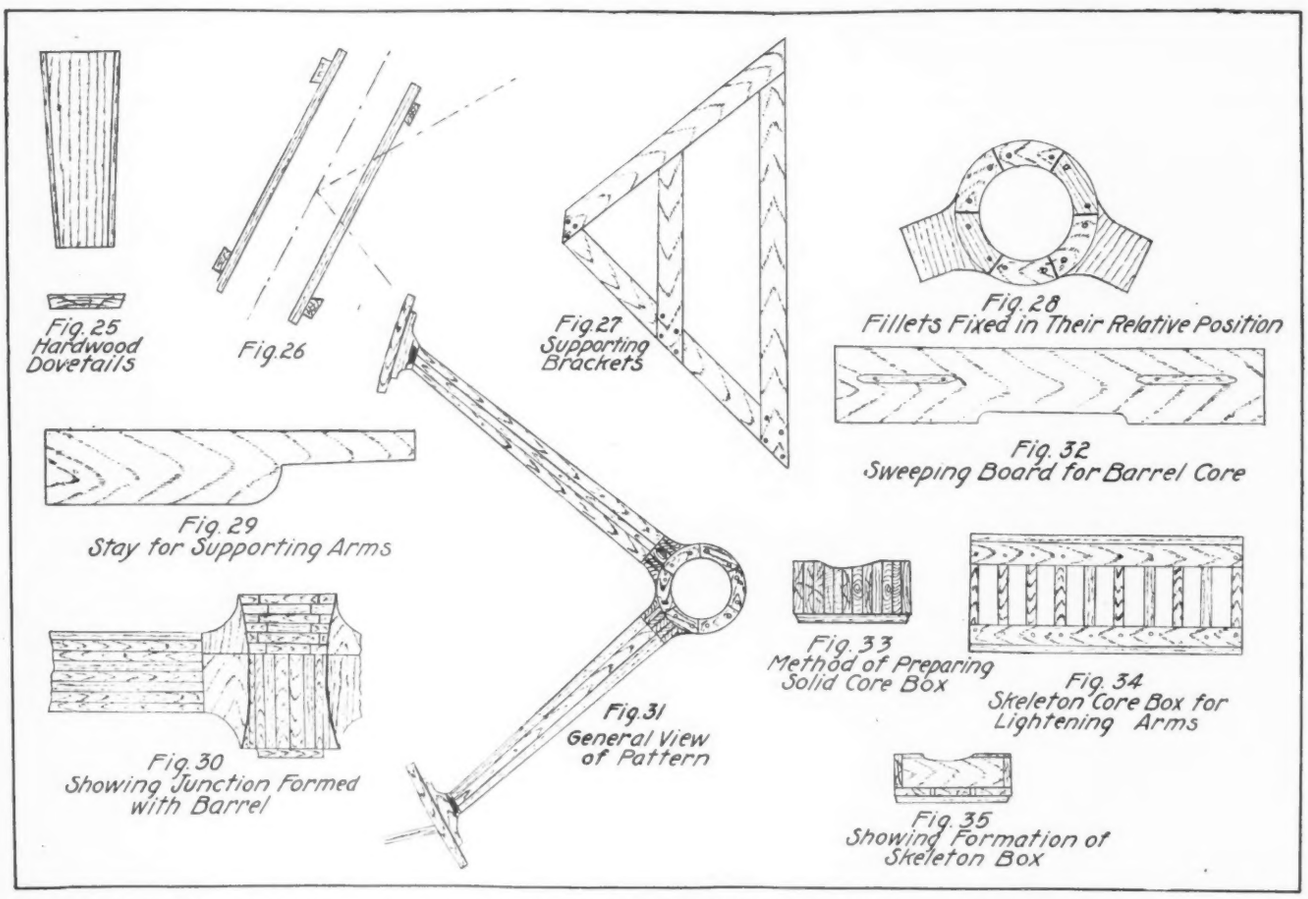



FIG. 25—PROPER SHAPE OF DOVE TAILS FIG. 26—ARRANGEMENT OF A PLATFORM OF TWO BOARDS TO HOLD THE BARREL FIG. 27—A PLANE FITTED BETWEEN THE ARM AND AGAINST THE BOX TO MAKE THE PATTERN MOLD FIG. 28—APPEARANCE OF FILLETS WHEN FIXED IN THEIR RELATIVE POSITIONS FIG. 29—TEMPORARY BARS TO BE FITTED ON TOP OF THE ARMS FOR RIGIDITY FIGS. 30 AND 31—VIEWS OF FINISHED PATTERN SHOWING CONSTRUCTION OF ARMS WITH BARREL AND GENERAL PLAN VIEW OF PATTERN FIG. 32—BOARD FOR SWEEPING UP BARREL CORE FIG. 33—METHOD OF MAKING SOLID CORE BOX FOR CENTER CORE FIGS. 34 AND 35—METHOD OF CONSTRUCTING A SKELETON CORE BOX FOR LIGHTENING ARMS

finished as it is put on, the building beginning at the bottom. When the face thickness of the palm is finished, lines should be set on it as a guide for the second thickness. When this is being built, the shape of the arm will have to be drawn on the face and the fillet cut similarly to the fillet at the boss. When building the front face to the mock, as well as truing each thickness to the one below, every third or fourth piece should be screwed into the mock to insure stability, the precaution of covering these screws being taken when fitting the second thickness. Palms made in this way are practically indestructible. The crossing prevents warping, and shrinkage due to atmospheric conditions are infinitesimal.

*Making the Dovetails*

The dovetails have still to be made. Hard wood such as teak should be used for them, and they ought to be 1½ inches thick. The width is decided by the width of the arms, enough timber being left on either side of the slot to insure strength. The taper of the dovetails should not be too great, but about the same as shown in Fig. 25. They are not the full depth of the arm as they do not project through to the top fillet and the top segmental part of the barrel must be taken off before it is possible to draw the arms. The shape of the dovetails should be very accurately drawn on the fillet blocks, and when the slots are cut the fillets can be fitted. Having been left long they can be cut off to the exact length when fitted. It is not bad practice to cut the dovetails short of the bottom, and a slot having been cut through for convenience, a piece can be fitted in and will act as a stop, and prevent the dovetails from slipping down too far if the timber shrinks. These dovetails should be well screwed to the arms, and after their accuracy has been proved by trying the arm in place it does no harm to insert a couple of dowels.

It may be explained that this bracket is a naval design and the flange, *A*, Fig. 2, goes through the shell, and is riveted to the protected deck. It may be possible to make the flange out of one-thickness timber but if the shape is much contorted it may be necessary to build it of thicknesses as the palms were built and shape them afterwards.

The various parts being finished the pattern has now to be erected. If every piece has been accurately made this is not a very difficult matter. Almost everything depends upon the exact placing of the barrel. A platform of two boards, placed on edge, and either parallel to each other, Fig. 26, or forming a cross must be screwed to the floor, and check pieces to guide the barrel into position may be screwed to them. It is well to fix the barrel to these skids by means of square blocks screwed to them, and to the bottom of the barrel. The width of the skids on which will depend the height of the barrel is determined by the height of the palms on the mocks. The arms may simply be dropped into position. Very little tool work should be necessary. It will be necessary to pocket screw the arms to the fillet blocks at the boss.

Two temporary bars about 2 inches thick, Fig. 29, should be fitted on the tops of the arms and checked to cross the boss. They will keep the arms rigid and the molder can unscrew them when he has the batten part rammed up. It is not wise, however, to leave the arms this way without making quite sure that they will not spring further. The best way to do this is to make a strong half-lapped frame, as shown in Fig. 27, fitted between the arms and against the boss. The molders need not detach this until they have part rammed the mold, and it should be put back after every casting. It is not wise to leave the screwing up of such a pattern to the molders, as they cannot know when the pattern is correct.

Before the pattern is removed it should be examined by the person responsible for the design, and then by the foreman-patternmaker to see that contraction allowances are right.

After the work has been approved the mocks can be taken away and the rib of the face of one palm screwed on. To get the print fixed on the underside of the barrel the pattern will have to be raised by the crane. If the foundry is adjacent to the pattern-shop or close at hand it may be conveyed to the foundry as a whole but if it has to be conveyed by rail it is better to take it to pieces as it is not a difficult or long job to screw it together in the foundry. Figs. 30 and 31, show the finished pattern. The center core of the boss and lightening core of the arms must be made. The former is run up on a horizontal spindle and board, as shown in Fig. 32. It should be left about a foot longer at each end. Sprigs or chisel cuts in the edge mark the length of the core, diameter gage pieces being nailed on top. Some craftsmen, when making a loam sweeping board, chisel the shape square through the thickness of the board, and bevel it to a ¼-inch line afterwards. It is quicker and more practical to saw almost to the line first and then bevel it, and finally trim the ¼-inch edge. If a few castings are wanted it is good practice to screw a strip of hoop iron on the face of the board. This board need not be inset.

The construction of the arm core box depends very much upon whether the foundry wants a solid full core box or will be content with a half box, the top half being swept. If a solid box has to be made it should be jointed up of 1½-inch timber, as shown in Fig. 33, and battens can be screwed on the bottom. However a skeleton box, as shown in Figs. 34 and 35, may be used. It will be observed in Fig. 35 that an open jointed plate is made and cross battened and on this two sides are screwed. Grounds of the correct shape have to be screwed into this box 2 or 3 inches from each other. They should be kept about ¾-inch from the top, so that top binding plates can be put on. If the top is swept off end plates must be screwed with the shape cut from them so that a straightedge can be used for sweeping off the sand. The end of this core is rounded off, but the patternmaker may ignore this. The radius is not important, and the molder cards or rubs the end of the core to a good shape. Nothing remains to be done but to paint the print and mark all screws which have to be withdrawn in the foundry. In these castings at a joining of the metal where the plating is riveted no fillets should be made. This is usually stipulated on the drawing. It is as well to write directions of this kind on the pattern, so that a mistake will not be made in the foundry, as it is a costly matter and sometimes impossible to have the fillets machined off afterwards.

## Norton Co. Reorganizes

The business of the Norton Grinding Co., manufacturer of grinding machines, has been taken over by the Norton Co. and hereafter the grinding machine and grinding wheel business will be conducted as a single enterprise under the name of the Norton Co., Worcester, Mass. George I. Alden, president of the Norton Co., will be president of the board of the new company. Charles L. Allen becomes president and general manager, Aldus C. Higgins, treasurer and general counsel, and George N. Jeppson, secretary and works manager. As was announced recently, Ross C. Purdy has left the exclusive employ of the company to engage in consulting practice in Buffalo but will continue as consulting engineer for the Norton Co. Lewis E. Sounders, Niagara Falls, N. Y., manager of the abrasive plant will be transferred to Worcester to take up the work of research engineer in connection with his other duties. The company has acquired control of the Hiroshima Grinding Wheel Co., near Kobe, Japan, where abrasive products will be made.

# Belgian Foundries Tricked Germans

## Though Faced by a Continuous and Increasing Shortage of Raw Materials, and Limited by Restrictions on Gas and Electricity, the Foundrymen of Occupied Belgium Found Opportunity to Produce Castings

BY IVAN LAMOUREUX

*Sheer audacity characterized many of the activities of the Belgian people during the period of occupation. That perky little paper, which periodically jabbed the stolid German authorities and defied all efforts to trace, capture and punish its publishers, is well known. Similar in many ways to the spirit which actuated La Libre Belgique was that which prompted Belgian foundrymen to improvise and scheme to trick the Germans, by operating clandestine foundries under the very eyes of military authority. M. Ivan Lamoureux, in this article, which was written for the interesting new publication* Revue de Fonderie, *tells how this was accomplished.*

MOST of the foundries in the Liege district in Belgium had to stop work in 1916 by order of the German authorities. Among those which remained active, were some of which the invader was unaware, some whose production was needed for useful public work, and finally those that involuntarily or otherwise assisted in the foundry work required for the support of the German army.

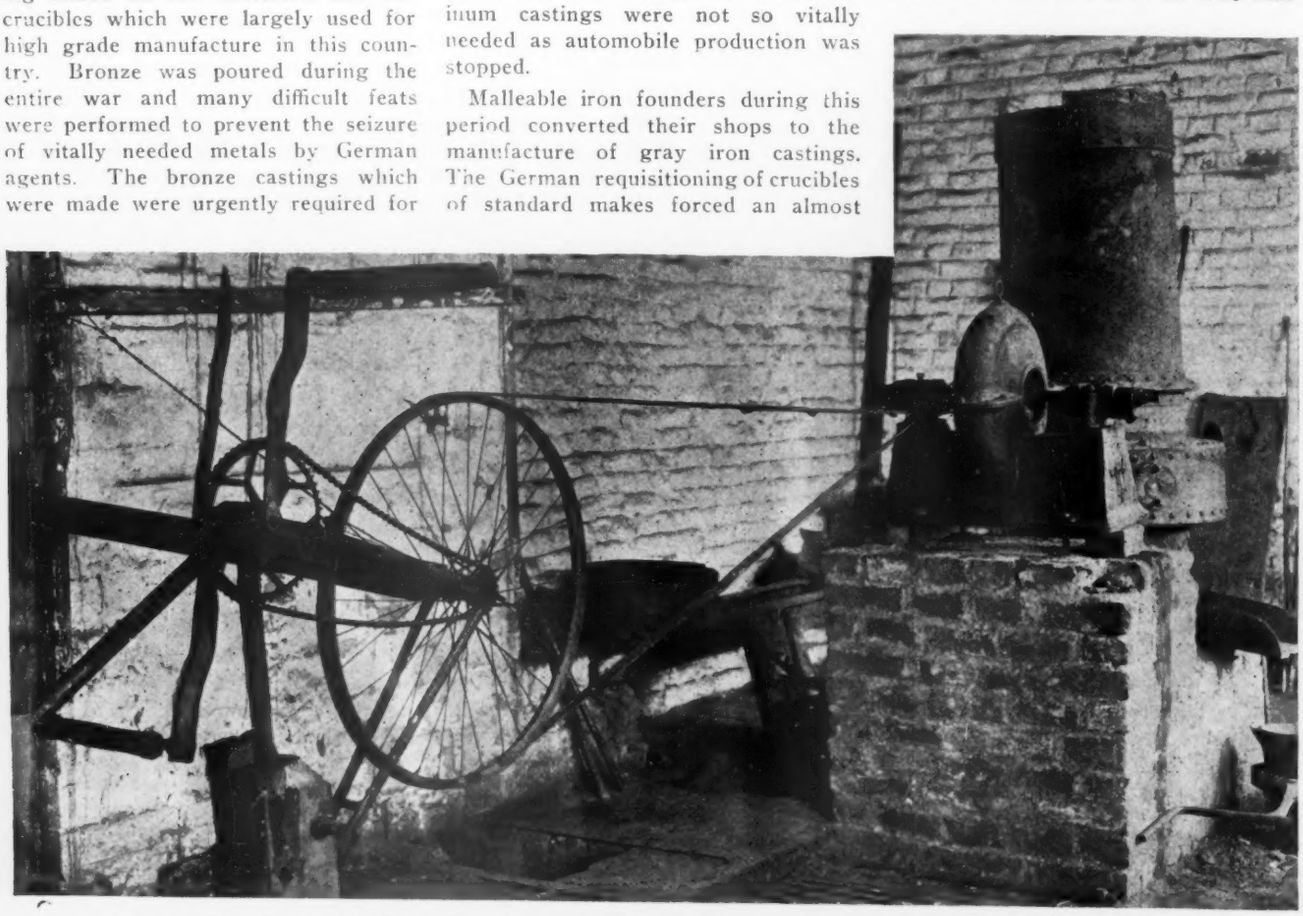
Despite the complete stoppage of large industries and the absence of raw materials, other than those which were to be found in Belgium, and which had escaped the enemy requisitions, small iron foundries continued secretly to cast small machine parts and all kinds of hardware.

The malleable iron foundries were not active except at the beginning of the war, the German authorities having seized all raw materials and the crucibles which were largely used for high grade manufacture in this country. Bronze was poured during the entire war and many difficult feats were performed to prevent the seizure of vitally needed metals by German agents. The bronze castings which were made were urgently required for local street railways and for machines and motors which were in use. Aluminum castings were not so vitally needed as automobile production was stopped.

Malleable iron founders during this period converted their shops to the manufacture of gray iron castings. The German requisitioning of crucibles of standard makes forced an almost unheard of rise in price. Common makes of crucibles reached a price of 12 francs per unit of capacity. This would be about $1.20 for each pound of rated capacity. As much as $200 was paid for a crucible holding 220 pounds.

Foundries which were prevented from operating their regular shops built small improvised cupolas from materials at hand. These were hidden away and operated clandestinely. They ranged from 8 to 13 feet high and were only 12 or 18 inches in diameter. Some were built with a square section. One of the small improvised cupolas of standard design is shown in the accompanying illustration.

During the German occupation gas and electricity were strictly limited. It was impossible to secure current to operate motor blowers. For this reason a makeshift such as that illus-



SMALL IMPROVISED CUPOLA BLOWN BY A HOME-MADE HUMAN MOTOR WHICH WAS USED IN A FOUNDRY CLANDESTINELY OPERATED IN OCCUPIED BELGIAN

trated was frequently resorted to for operating the cupola fans. In this case a bicycle was converted into a stationary power unit. The front fork was removed, the machine inverted and firmly anchored and the back wheel was belted to the drive pulley of the blower. The cranks to which the pedals had been fastened were extended to double the former length and wooden handles replaced the pedals.

Two men turned this power unit, three shifts of two men each taking turns in turning the cranks to operate the blower. The melting period of the small cupola was two hours with a fan speed of as high as 2000 revolutions per minute. In ordinary practice a one horsepower motor served to drive a blower of the size used.

These small hidden foundries operated practically during the entire war, making door hardware, furnace grates, small coffee and flour mills and other mechanical devices and hardware which were in great demand.

## Banking the Cupola

*By F. J. Grondie*

Banking a blast furnace for a month or two is fairly common practice. Cupolas have been banked also but from the nature of conditions which prevail in a foundry they have never been banked for any extended period of time.

I have read occasionally of cupolas being banked for several hours but I had an experience recently which may prove interesting to foundrymen who are doubtful how long a cupola can be held and still give satisfactory results. The case is not conclusive by any means, but it proves that a cupola may be held for at least 18 hours without detriment.

The experiment was tried on June 26 with a 72-inch cupola at the plant of the Kilby Manufacturing Co., Cleveland. On this occasion the furnace was charged in the usual way with a coke bed of 3600 pounds and 4000 pounds of iron. This was followed by six alternate layers of 400 pounds of coke and 4000 pounds of iron. When filled to the charging door, the cupola had a capacity of 12 tons of iron. Charging was finished at 1:30 p. m. and the intention was to put on the blast at 2:30 p. m.

When the melter attempted to start the blower motor, the starting box blew up owing to crossed wires. The wreck was so serious that casting was out of the question for several hours. We were confronted with the alternative of dropping the bottom or holding the furnace until the following morning. It was decided to adopt the latter course. The furnace man was instructed to close the tuyeres and the gate in the blast pipe in order to prevent any air from reaching the fuel.

Repairs to the starting box were effected during the night and the blower was started at 7:30 next morning. In about five minutes the iron came down, as hot as usual. The remainder of the iron, 28 tons in all, was afterward charged in the regular way and came through as readily as if there had been no delay.

## Locomotive Wheel Pattern

In making the pattern shown in the accompanying illustration for a 56-inch locomotive driving wheel the first step was to transfer the shape and dimen-

LOCOMOTIVE DRIVING WHEEL PATTERN

sions full size from the blueprint to the layout board. As the casting was to be made of steel all measurements were made with a $\frac{3}{32}$-inch shrinkage rule. Having checked up the different sizes, the next step was to plan a mode of construction which would result in the strongest pattern with a minimum of labor and expense and this was accomplished in the following manner:

Lumber of a suitable thickness was selected and three rows of segments, six to a circle, were prepared. They were first sawed on the band saw to a template and then the ends matched on a jointer. The top and bottom layers were nailed and glued to the layer in the center; the joints in each course being located half way between the joints in the preceding course. This method is universally practiced among pattern-makers and produces strong patterns.

The ring was attached to a face plate and put in a lathe where it was turned down to size and finished. It was then taken out of the lathe and sent back on the layout board to facilitate fitting the hub and arms. Having located the points where the arms would come in contact with the rim, notches were cut at these points into which to check the ends of the arms. The main piece for the center was then made the arms *M* and *N* forming integral parts of it. This center piece was tacked in place temporarily while the arms from *C* around to *D* were being fitted, nailed and glued into place. The piece for the balance weight *E* was next made and fitted and then the short arms *F*. The arms were roughed out before setting them in their places but were finished and sand papered after the pattern was assembled. The covering piece *A* was then put on the hub; this not only covered all the joints but also bound the center together. The prints *J* and *K* on the hub and the pieces *G* and *H* on the rim were first sawed to size then finished on the sander and fastened in place. The pattern was then checked for dimensions all over and being found O. K. was shellaced and shipped. This pattern was made by the Johnston Pattern Co., Canton, O.

## Cupola Not Suitable for Melting Bronze

(*Continued from page* 520)

the metal is much hotter and since it is held on the hearth until the entire charge is melted, the mixture will be more homogenous.

In summing up, my practical experience leads me to believe that manganese bronze, Stone's bronze and phosphor bronze should not be melted in a cupola.

Satisfactory gun metal, that is the mixture made up of copper 88 per cent, tin 10 per cent and zinc 2 per cent may be made in a cupola provided the blast is not too strong. A blast which is too strong will result in oxidizing the metal or burning it up. On the other hand if the blast be too weak sufficient heat will not be developed to melt the metal at a casting temperature. In melting gun metal in this manner, the copper is melted in the cupola and tapped into a highly superheated ladle. The tin and zinc are added in the ladle.

The Pittsburgh Malleable Iron Co. recently took title to the old plant of the General Chemical Co. adjoining its own property. The chemical company plant, which has been idle for several years, contains a number of substantial manufacturing buildings and an office building on a site containing more than seven acres located on Fifty-seventh street between the plants of the Atlantic Refining Co. and the McConway & Torley Co., and extends from the Pennsylvania railroad to the Allegheny river.

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## Wages and Low Cost

FOUNDRIES make castings for financial profit, therefore, it would seem to the superficial thinker that the superintendent who makes the cheapest castings, providing the quality of the work is equal, is the best executive for the company. But this is not necessarily true. A superintendent may be able to drive his workmen to get out a large amount of work at low cost, but how long will he be able to keep it up and what will the next superintendent be able to do with the organization built up on forceful driving? It may be possible to get out cheaper work by continuing on without adopting the latest machines for saving arduous labor, or by grinding down wages, but how long can competent workmen be retained under such conditions? The company which puts the cost consideration so far above every other factor that the welfare of its workmen is not given ample consideration will eventually see the fault in such a policy and be forced by conditions to change its tactics. The superintendent of real ability is able to make castings cheap and at the same time pay the men current wages and give them good working conditions. Unless he can do this he has not reached the mark which distinguishes a man of superior resources. Conditions in the industrial world are so changing that in the future no executive will be considered successful who does not advance the conditions of his employes as well as show a low manufacturing cost. In other words, the man who lacks ability to devise cheap manufacturing methods will not be able to hold his position through exactions upon the workmen.

## The Thorny Path of Progress

HUMAN nature needs an incentive in order to improve standards which have become fixed through years of satisfactory use. An example of this is found in the change which has come over the malleable castings situation in the past few years. In 1915 malleable foundrymen protested against the specifications of the American Society for Testing Materials claiming that a minimum tensile strength of 40,000 pounds per square inch was excessive, and through their endeavors the society lowered the requirements for tensile strength to 38,000 pounds. Then the manufacturers began to realize that the low strength of their material made it difficult to compete with steel castings, something which was becoming more and more essential to the success of the malleable-castings industry. Spurred on by this incentive the malleable foundrymen got together and under the direction of a trained metallurgist so improved their metal that last year they voluntarily came to the Testing society and asked that the tensile requirements be raised to 45,000 pounds, and now they are figuring on future increases. This will enable malleable castings to enter fields at present dominated by steel. But great as is the opportunity for improvement in the malleable field, the steel casting has before it a line of development which as yet has been practically untouched, namely that of heat treating by quenching and drawing. When this work is further developed the malleable casting will encounter new ruts on the road to success and the steel casting will also enter the field as a strong competitor of the steel forging.

# Trade Outlook in the Foundry Industry

IMPETUS, which was imparted to practically every branch of the foundry industry by the June gain in orders, has carried along well through July. If the present rate of increase in business is continued through next month, September will see most plants working to full capacity and with orders running well ahead to the first of the year. The problem of labor is growing steadily. Many shops report that though they are working to the limit of production with the mechanical facilties at hand, they are unable to get out more work with the labor available. Malleable plants and nonferrous foundries particularly are hampered.

**Brass Demand Is Heavy**

Steady increases in the demand for brass castings has resulted in bringing many shops squarely face to face with a labor shortage. Nonferrous plants are working to full capacity limited only by the supply of labor. Plumbing goods, following the steady upward sweep of building activity, are especially sought. Progress in meeting the acute housing situation, due to halted non-war construction over a period of about two years, has brought an exceptionally heavy demand for plumbing fittings. Reports indicate that June of this year excelled June, 1918, by nearly three times in the total amount of buildings under construction. Jobbers and dealers have been caught with depleted stocks, and the result has been a general scramble for this class of brass castings. General machinery business, also is exercising a strong influence on nonferrous foundries, and the automobile industry is a large factor in the demand for brass, bronze and aluminum castings. A general raise in price of copper-bearing alloy castings is expected. Prices of all nonferrous metals have advanced, but copper leads all. During the past two weeks copper has advanced from 19 and 19.25 cents to 23 cents a pound. For the period of the war, practically all use of copper except for war purposes has been suspended throughout the world. Despite an enormous surplus accumulated, it is apparent that the demand for the metal both in this country and abroad is almost unlimited. Practically no surplus exists except that which is held by the producers. This condition augmented by labor troubles in the mines has produced the rise in price. Manufacturers of copper and brass products in many lines have increased their prices steadily and copper bearing castings are expected to be affected soon. The prices of nonferrous metals based on New York quotations follow: Casting copper, 23c; lead, 5.75 to 5.80c; tin, 70 to 71c; antimony, 9.50c; aluminum, No. 12 alloy, producer's price, 31.50c, and open market, 27 to 28c. Zinc is quoted at 8 to 8.10c, St. Louis.

Steel foundries still are the least active of the various branches of the industry. Automobile and tractor manufacturers are practically the only consistent buyers of steel castings.

**Prices of Raw Materials for Foundry Use**

CORRECTED TO JULY 25

| Iron | | Scrap | |
|---|---|---|---|
| No. 2 Foundry, Valley | $26.75 | Heavy melting steel, Valley | $21.50 to 22.50 |
| No. 2 Southern, Birmingham | 25.75 to 26.75 | Heavy melting steel, Pittsburgh | 21.00 to 21.50 |
| No. 2 Foundry, Chicago | 26.75 | Heavy melting steel, Chicago | 20.00 to 20.50 |
| No. 2 Foundry, Philadelphia | 28.00 to 29.60 | Stove plate, Chicago | 21.50 to 22.00 |
| Basic, Valley | 25.75 | No. 1 cast, Chicago | 27.50 to 28.00 |
| Malleable, Chicago | 27.25 | No. 1 cast, Philadelphia | 23.50 to 24.00 |
| Malleable, Buffalo | 27.25 | No. 1 cast, Birmingham | 22.00 to 23.00 |
| | | Car wheels, iron, Pittsburgh | 22.00 to23.00 |
| Coke | | Car wheels, iron, Chicago | 25.50 to 26.00 |
| Connellsville foundry coke | 5.00 to 5.50 | Railroad malleable, Chicago | 23.00 to 23.50 |
| Wise county foundry coke | 7.00 to 7.50 | Agricultural malleable, Chicago | 22.00 to 22.50 |

**Malleable Is Hampered**

Although still operating at a little better than 70 per cent, the malleable foundries are near capacity production with the men available. Malleable manufacturers are not peculiarly situated in this regard, but the effect is felt more in the face of a returning demand for agricultural castings and a fair volume of railway repair work. That the ever-cautious farmer has realized the remote possibility of lower prices, is demonstated by the building up of inquiry from agricultural implement makers. Tractors, too, are more strongly in demand under the general revival of farm machinery buying. While over 132,000 tractors were built in this country last year, it is estimated that this year's production will be over 300,000. Repairs which were ordered upon grain, coal and refrigerator cars recently have brought a fair amount of railway business to the malleable shops. The automobile industry continues to be a dominating factor and those malleable plants which specialize in this class of work are working at full capacity. The labor situation is far from satisfactory in this as in other branches of foundry work, and as wages enter largely into the cost, higher prices for malleable castings are anticipated. Large sales of malleable grades of pig iron are reported.

**Gray Iron Near Limit**

Many gray iron foundries, including of course the automobile plants which for some time have been most active, are operating nearly at capacity. In the east the machinery manufacturing establishments have felt a steadily increasing impetus during the past month. The present price level in eastern foundries is regarded as a minimum. The scarcity of day laborers is especially acute, and will no doubt exert an influence in expected price increases. Common day laborers now receive $4 for nine hours' work and they are difficult to obtain even at this price. Foundry iron sales indicate the anticipation of continued heavy demand for castings. Inquiries are being made for 1920 delivery on pig iron, although most furnaces have not yet opened their books for first half business. One large purchase during the past week which was placed in the Buffalo district was 10,000 tons by the New York Air Brake Co. Railroad buying has brought some business to gray iron shops both in the east and central west. Cast iron pipe sales are mounting steadily. The price of pipe in the Chicago district has advanced $2 per ton. Four-inch pipe is now quoted at $56.80 a ton and 6-inch and larger is $53.80. The demand for foundry coke reflects the building up of business in gray iron shops, and a strong tendency to increase storage for winter use is apparent.

# Comings and Goings of Foundrymen

CHARLES L. WARWICK has resigned his position as assistant professor of structural engineering at the University of Pennsylvania in order to accept the office of secretary-treasurer of the American Society for Testing Materials. With the new quarters of the society in the Engineers' club, Philadelphia, Mr. Warwick will devote all his efforts to his new position. This will give opportunity for broadening the work of the society. Mr. Warwick was graduated in civil engineering at the University of Pennsylvania in 1919. Since that time he has been connected with the teaching staff of the university. He has been active in the affairs of the society since 1909 when he took up the work of editorial assistant to Dr. Marburg, at that time secretary of the American Society of Testing Materials. His work eventually was extended to include secretarial work of an executive nature. In recognition of his service he was given the title of assistant to the secretary in 1917. One year later he was elected assistant secretary which position he has held until advanced to the full secretaryship.

H. G. Barbee has been made eastern manager of railroad sales with offices in New York for the Chicago Pneumatic Tool Co., Chicago.

D. C. Shulz Sr. has assumed the duties of sales manager for the Pittsburgh Crane & Equipment Co., Sharpsburg, Pa.

George Stich, formerly with the Huntington Steel Foundry Co., Huntington, Ind., has accepted a position with the Union Sanitary Mfg. Co., Noblesville, Ind.

H. E. Meyer, chief clerk of the war minerals relief commission, has been appointed chief clerk of the bureau of mines and C. P. Robertson succeeds Mr. Meyer.

George M. Covey, who was formerly with the Hook Foundry Co., Marcus Hook, Pa., has taken charge of the Fairbury Windmill Co., Fairbury, Nebr.

David B. Sutton has become sales manager of the Thatcher Propeller & Foundry Corp., Albany, N. Y., which was formerly the George H. Thatcher Co.

Victor E. Rehr, general manager of the Aetna Foundry & Machine Co., Warren, O., has been elected to the board of directors of the company, to succeed W. W. Ludt, recently resigned.

W. H. Goldstine has resigned his position as manager of the gray iron foundry of the Michigan Motor Castings Operating Co., Flint, Mich., the plant of the Buick Motor Co., to accept a position with the Nash Motor Car Co., of Kenosha, Wis.

L. C. Sprague, formerly district manager of sales in New York for the Chicago Pneumatic Tool Co., has been made western manager of rail-

CHARLES LAURENCE WARWICK

road sales for that company. Nelson B. Gatch, formerly district manager in Chicago, has been assigned to Mr. Sprague's New York territory.

William A. Nugent, who recently received his discharge from the Twenty-first Engineers, with which unit he served in France, has resumed his position as Indiana sales representative with the Independent Pneumatic Tool Co., Chicago.

Wilford L. Stork, metallurgist for the Michigan Motor Casting Co., division of the Buick Motor Co., has resigned to become associated with the Detroit Valve & Fitting Co., Wyandotte, Mich., as foundry superintendent.

W. C. Greer, who recently accepted a position with the McKenna Brass & Mfg. Co., Pittsburgh, formerly was superintendent of the Seward Foundry, following his service as foreman for the Verona Steel Castings Co., and the Pittsburgh Brass Mfg. Co., Pittsburgh.

Robert Voigtlander, who for the past seven years was manager of the architectural iron and bronze department of the Robert Mitchell Co., Ltd., Montreal, Can., has been made southern sales manager of the Southern Brass Mfg. & Plating Co., Houston, Tex. Mr. Voigtlander's experience includes 19 years employment and association with brass foundries.

W. B. Douglas has been appointed superintendent and A. E. Nyberg production manager of the W. & B. Douglas Co., Middletown,, Conn., maker of pumps. Mr. Douglas is vice president of the company and Mr. Nyberg formerly was cost, production and stock expert with the Remington Arms-Union Metallic Cartridge Co., Inc., Bridgeport, Conn.

J. J. Brown, formerly vice president and general manager of the Wheeler Condenser & Engineering Co., Carteret, N. J., has been elected president of that company, succeeding Charles W. Wheeler who died recently. H. S. Brown, who was elected vice president at the same time, formerly was New England manager for the Power Specialty Co. and also is president of Brown-Ferries Co., Philadelphia.

T. S. Disler, who for several years has been traffic manager of the Fort Pitt Steel Casting Co., McKeesport, Pa., now also is purchasing agent of that company. H. H. Nicholson, auditor of the company, hitherto has taken direct charge of purchases. Mr. Disler before becoming identified with the Fort Pitt Steel Casting Co., was a traveling freight agent for the Baltimore & Ohio railroad.

J. Lewis Hay, of the Hay Foundry & Iron Works, Newark, N. J., has organized a group of foremen of various departments to study modern production methods. The subjects covered will include the handling of men; materials, from purchase to final product; plant layout; principles of organization; cost finding and cost accounting; industrial relations; employment; welfare; and safety.

I. Hall, managing director of the Monometer Mfg. Co., Ltd., Birmingham, England, will arrive in New York early in August in connection with business of his firm which expects to establish an American plant to manufacture its products. Mr.

Hall is the inventor of a number of furnaces for melting, annealing and heat-treating metals. He will make his headquarters, while in this country, at the Hôtel Astoria, New York.

John T. Jans has joined the engineering force of Holcroft & Co., foundry furnace and oven specialists, Detroit. Mr. Jans was graduated from the University of Michigan in the class of 1912 and later received a master's degree from his university. He was 21 months in France with the Sixteenth Engineers and helped construct about 150 miles of standard gage railway while there, beside much other important work on the Argonne front. He left the service recently with the rank of captain.

Arthur J. Coldwell has been made assistant general superintendent for the Klaxon Co., Newark, N. J. On Aug. 15, 1918, Mr. Coldwell severed his connection with the Coldwell Lawnmower Co., Newburgh, N. Y., after an association of 15 years to become production engineer for the ordnance department in the plant facilities section, New York district. In January of this year he secured his release from the service and entered the employ of the Klaxon Co. as efficiency engineer of the company.

# What the Foundries Are Doing

## Activities of the Iron, Steel and Brass Shops

A foundry, 70 x 160 feet, will be erected by the Philadelphia Sash Weight Works, Philadelphia.

An office building will be erected at the plant of the Hay Foundry & Iron Works, Newark, N. J.

The Aero Cushion Tire Co., Wingham, Ont., has purchased two buildings from the Western Foundry Co.

An extension to the plant of the Bryan Pattern Machine Co., Bryan, O., is contemplated.

The J. P. Devine Co., 1372 Clinton street, Buffalo, will build a foundry, 90 x 225 feet.

Erection of a foundry is contemplated by the Chester Iron Foundry Co., St. Louis.

A contract has been let by the American Malleable Castings Co., Marion, O., for the erection of a foundry addition, 60 x 70 feet.

Arrangements are being made for the erection of an office building, 2-stories, 50 x 80 feet, for the Sivyer Steel Casting Co., Milwaukee.

J. F. Ancona, architect, 190 Birr street, Rochester, N. Y., has plans for the erection of a foundry addition. The name of the owner is withheld.

The Wagner Mfg. Co., Toledo, O., has let a contract for the erection of a foundry and machine shop.

A building permit has been granted the Allyne-Ryan Foundry Co., Cleveland, to erect a plant addition, 40 x 140 feet.

The National Malleable Casting Co., Cleveland, is reported planning the erection of a laboratory, 3-stories, 49 x 62 feet.

A new corporation is to be formed to take over the plant of the Thomas Track Appliance Co., Kansas City, Mo., which operates a foundry.

Contracts have been let for the erection of an addition to the plant of the Detroit Gray Iron Foundry Co., Detroit.

The general contract has been let by the Peninsular Brass Works, Detroit, for the erection of a foundry.

The Bond Foundry & Machine Co., Manheim, Pa., recently let a contract for the erection of an addition to its plant.

Alterations are being made at the plant of the Center Foundry & Machine Co., Main and Twentieth streets, Wheeling, W. Va.

The Damascus Bronze Co., 928 South avenue, Pittsburgh, is taking bids for the erection of a plant, 66 x 75 feet.

The Craven Foundry & Machine Co., Newbern, N. C., is reported contemplating the erection of a machine shop and foundry.

The Owosso Bronze Bearing Co., Owosso, Mich., has started on the erection of a foundry and machine shop, both, 40 x 100 feet.

The Jewell Steel & Malleable Co., Buffalo, is enlarging its foundry on Hertel avenue and is also erecting an extensive pattern storage addition.

Bids are being taken for the erection of an addition to the plant of the Malleable Iron Range Co., Beaver Dam, Wis. Lockwood, Green & Co., consulting engineers, Chicago, are in charge.

W. S. Hoffman, 329 Tucket street, Syracuse, N. Y., is building a foundry and power house, 50 x 200 feet.

A contract for the erection of a plant addition, 25 x 125 feet, has been let by the Butler Street Foundry & Iron Works, Chicago.

The John Van Range Co., Cincinnati, stove and range manufacturer, has leased a building which it will utilize for a plant addition.

The West Bend Aluminum Co., West Bend, Wis., is purchasing equipment for its new plant which was recently completed.

An addition to its foundry is being built at the plant of the Grand Rapids Brass Co., Grand Rapids, Mich.

The plant of the National Castings Co., South Haven, Mich., recently was damaged by fire. The loss has been estimated at $10,000.

The Homestead Valve Co., Homestead, Pa., has awarded the Austin Co., Cleveland, a contract for the erection of a foundry, 27 x 40 feet.

Bids have closed for an addition and alterations to the foundry and storage buildings of the Crompton & Knowles Loom Works, Worcester, Mass.

Contractors are rebuilding the plant of the Bostic Stove Co., Lapeer, Mich., which recently was damaged by fire.

Erection of a plant addition is contemplated by the Sunway Stove Co., Delaware, O. Architect Frank Mason is preparing plans for the building.

The American Manganese Bronze Co., Philadelphia, contemplates the erection of a plant addition, 21 x 65 feet.

A contract has been awarded by the Lutz Co., Hayes avenue, Camden, N. J., for the erection of a pattern shop, 48 x 66 feet.

The Gravios Foundry Co., 5001 South Thirty-eighth street, is reported contemplating the erection of a foundry, 62 x 235 feet.

The American Radiator Co., New York, has purchased a plot at Laurel Hill, L. I., for future plant extensions.

Contract for the erection of a 3-story, 25 x 40-foot pattern storage building has been awarded by the Rhode Island Malleable Works at a cost of $18,000.

The Southern Foundry & Machine Co., Nashville, Tenn., has increased its capitalization from $75,000 to $200,000.

The Sommer-Adams Co., 2934 East Fifty-fifth street, Cleveland, has awarded contracts for the erection of a foundry and machine shop, 60 x 120 feet.

Purchase of the Dockery Brass & Iron Co., Zanesville, O., by Louis H. Wise, has been reported. The new owner is said to be planning to make extensions to the foundry and machine shop.

The Adrian Brass & Aluminum Casting Co., Adrian, Mich., recently was incorporated with $25,000 capital, by Frank Bachrach, Morris Schmitzer and Louis Frank.

F. Ferguson & Son, 1122 Clinton street, Jersey City, N. J., operating a foundry for the manufacture of grate bars, is reported planning the erection of a new foundry building.

The United Roll & Foundry Co., Ravenna, O., is expected to start shortly on the construction of a plant addition to be occupied by a foundry and machine shop.

The Samson Tractor Co., Janesville, Wis., is preparing to start work on the erection of a foundry as the third unit of its plant. The addition will be 300 x 500 feet.

The Lycoming Foundry & Machine Co., Williamsport, Pa., has started on improvements to its plant including the erection of a 3-story office building and machine shop addition.

Two plant additions, 25 x 48 feet and 85 x 90 feet, will be erected at the plant of the Star Foundry Co., Troy, O., of which W. T. Anglemeyer is president.

The Northern Aluminum Co., Ltd., Toronto, Ont., is reported planning to erect a plant. C. A. P. Turner, 1005 Lindsay building, Winnipeg, is in charge.

Construction has again been resumed on the new unit of the Saginaw Malleable Iron Co., Buffalo, after several weeks delay due to changes made in the specifications.

A foundry addition consisting of a 1 and 2-story building, 62 x 235 feet, will be constructed by the Gravois Foundry Co., St. Louis. The work will cost $10,000.

The Wagner Mfg. Co., Sidney, O., has awarded the contract for the erection of a 3-story, 50 x 70-foot machine shop and a 2-story foundry at a cost of $65,000.

The Ypsilanti Foundry Co., Ypsilanti, Mich., recently was incorporated with $100,000 capital to engage in a general foundry business. John H. Lonsky, 574 Delaware street, Detroit, George J. Zimmerman and J. C. Robinson are the incorporators.

A recent incorporation is that of the Eagle Foundry & Machine Co., Muskegon, Mich. The company, which is capitalized at $50,000, was incorporated by Charles Habel, W. E. Jeannot and A. Shaw.

The Rhode Island Malleable Iron Works, Hillsgrove, R. I., recently awarded a contract to Williams & Merchant, Inc., 86 Weybosset street, Providence, R. I., for the erection of an addition to its plant, 25 x 40 feet.

The Goodale Co., Kalamazoo, Mich., will triple its capacity by the erection of a foundry, 80 x 80 feet with a single cupola to manufacture brake shoes, and a foundry 140 x 280 feet, equipped with two cupolas and an oven.

The Volta Mfg. Co., Ltd., Welland, Ont., recently was incorporated with $100,000 capital, to operate

electric furnaces and to manufacture castings of all kinds. The company was incorporated by Robert T. Turnbull, John Young and Charles W. Sims.

The Parkersburg Rig & Reel Co., Parkersburg, W. Va., is planning to build a 1-story, 105 x 220-foot foundry. The cost including the equipment will probably total $150,000. Day & Zimmerman, 611 Chestnut street, Philadelphia, are the architects.

A new factory building, 3-story, 75 x 140 feet, is being planned by the National Copper & Smelting Co., Rose building, Cleveland. The building, which will cost $25,000, will be erected on Babbitt road at the New York, Chicago and St. Louis railroad tracks.

H. C. Johnson, Ltd., Bank of Toronto building, Montreal, Que., has been awarded the general contract for the erection of a $12,000 foundry building for the Canadian Steel Foundries, Ltd., 120 St. James steel, Montreal.

A foundry 80 x 119 feet and a machine shop addition 41 x 278 feet will be erected by the Omaha Structural Steel Works, 48 and Leavenworth streets, Omaha, Nebr. The costs of the buildings will be $20,000 and $25,000 respectively.

A 2-story, 75 x 75-foot addition is planned by the Basic Mineral Co., 834 Columbus avenue, Pittsburgh, manufacturer of a flux and deoxidizer for use in melting metals. The addition will consist of a mill, laboratory and warehouse and will cost $25,000.

Purchase of the Liebl & Retzlaff Machine Shops, Luxemburg, Wis., has been made by Edward Srnka. The machine shop and foundry which have again been opened for business will be known as the Luxemburg Garage & Iron Works.

A recent New York incorporation is that of the Superior Bronze & Aluminum Mfg. Co., Buffalo, which was incorporated to make castings of all kinds. The company, which is capitalized at $50,000, was incorporated by J. L. Dunn, W. D. Hopkins and E. O. Ploss.

The Keystone Iron & Steel Works, 937 North Main street, Los Angeles, Cal., is building the first unit of its new plant to be erected at Thirty-seventh street and Santa Fe avenue. The unit will be the pattern shop and office and will cost $200,000 including the equipment.

Plans are being prepared for a 3-story, 72 x 266-foot machine shop and a 1-story, 120 x 300-foot foundry addition to the plant of the Cleveland Metal Products Co., 1141 Ivanhoe road, Cleveland. The cost will be about $75,000. Contract for a 3-story, 60 x 90-foot assembly plant has been awarded recently at a cost of $120,000.

Through the chamber of commerce of Cleveland, it has been reported that the Drew Electric & Mfg. Co., an Indianapolis corporation, has purchased a 2-acre site in Cleveland, on which it plans to erect a plant, to include a machine shop and brass foundry. James H. Drew is president of the company.

The Thomas Mfg. Co., Montreal, Que., is building a large addition to its plant on Delisle street to take care of its rapidly increasing business. The gray iron foundry work has been discontinued at the main plant and a new modern foundry building, 74 x 100 feet, is being erected on Turcot street, adjoining the steel plant of the company.

The Heigeson Foundry Co. has been organized at Milwaukee to engage in the manufacture of gray iron and steel castings. Organizers of the new company are Andred Heigeson, A. L. Cannard, William Hoberg and Charles H. Greilling. A. W. Gregg, formerly of the Bucyrus Co., Milwaukee, will superintend the metallurgical work. The plant including the equipment will cost $100,000.

Work has been started on the first unit of the new plant of the P. A. Geier Co., Cleveland, manufacturer of vacuum cleaners and electric washing machines. This unit is erected on the large plot of ground recently acquired on 105th street between Elk and Barrett avenues. Five other units will be erected in the near future to house the foundry, power plant, machine shop, assembly plant and nickel plate plant. The total cost will be $50,000.

According to the information of Gus Meehan, manager of the Ross-Meehan Foundries, Chattanooga, Tenn., the company will at once start the construction of a large addition to its malleable iron plant. The building will be 130 x 300 feet of brick mill construction and when completed will increase the malleable output several thousand pounds per day. While the old malleable furnace will continue in use, new machinery will be installed for handling the iron. The foundry is manufacturing three grades of castings, steel, gray-iron and malleable castings for many different machines. Much of the product is exported.

An extension costing $100,000, including the equipment will be erected by the United States Hoffman Co., Syracuse, N. Y., manufacturer of pressing machines. One structure will be 1-story high, 80 x 200 feet, while another, a power house, will be 40 x 60 feet. The general contract for this work has been awarded to Dawson Bros., who will start work at once. Property has been purchased for the erection of an 80 x 100-foot foundry building at a later date. The company also contemplates moving its branch factory from Utica and merging it with its local plant.

# New Trade Publications

HOISTS.—A postcard folder, containing a number of descriptions of electric hoists in operation, is being distributed by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y.

AIR COMPRESSORS.—A 16-page booklet recently was published by the Union Steam Pump Co., Battle Creek, Mich., in which it describes and illustrates a complete line of air compressors, steam, belt and motor driven, and horizontal and vertical types. Capacities of the various compressors and other data are given.

LOCOMOTIVE CRANES. — A 32-page illustrated catalog has been issued by the Buffalo Hoist & Derrick Co., Buffalo, in which locomotive cranes and parts are described and illustrated. Steel is used in the construction of all vital parts and all spur gears have cut teeth. The booklet contains a number of line drawings.

WOODWORKING MACHINERY.—Catalog No. 19, in which woodworking machinery is described and illustrated, has been prepared by the P. Pryibil Machine Co., Inc., New York. Practically every woodworking machine made by the company is described and illustrated. The company also manufactures stud and bolt lathes, buffers and grinders and power transmission machinery.

FOUNDRY EQUIPMENT.—Sand-blasts and allied equipment is described and illustrated in a small booklet being distributed by the Pangborn Corp., Hagerstown, Md. Equipment described, includes, hose sand-blasts, cabinet sand-blasts, barrel sand-blasts, rotary table sand-blasts, room sand-blasts, dust arresters, dust exhausters, abrasive separators, moisture and oil separators, sand dryers, sand-blast cars, etc.

HOISTING MACHINERY. — The Contractors Plant Mfg. Co., Buffalo, has issued a 30-page illustrated catalog, in which it describes and illustrates hoisting engines and equipment. These engines are built upon the duplicate part system and all parts are interchangeable. Single drum hoisting engines, double drum hoisting engines, triple drum hoisting engines and compound geared swinging engines are among those described. Some valuable data are given.

CONVEYING EQUIPMENT.—An illustrated bulletin devoted to a description of the function, operation and construction of an overhead mechanical system for handling bulk packages and materials, is being distributed by the Sprague Electric Works of the General Electric Co., New York. The system consists of an overhead track on which hoisting and conveying machines are operated. The track is in the form of a continuous unbroken loop which is adjustable in length.

PLANT FLOORS.—An illustrated booklet has been issued by the Republic Creosoting Co., Indianapolis, in which wood block floors, manufactured by the company are described and illustrated. The illustrations cover a number of actual installations, among which are the plants of the Van Dorn Iron Works and the National Acme Co., both of Cleveland. The wood blocks are made from yellow pine which are treated in creosote oil, which according to the booklet makes them decay proof, dry and clean.

FLOOR GRINDER.—The St. Louis Machine Tool Co., St. Louis, is circulating a leaflet in which a heavy floor grinder is described and illustrated. This grinder is equipped with arbors which are larger than usual, are 0.40 per cent carbon steel and have coarse pitch, square threads. Bearings are long, have large oil chambers which are filled and drained through a pipe connection at the back and so arranged that the oil cannot overflow. The bearings are lubricated by chains. A number of accessories are described and illustrated.

CRANES.—The Chesapeake Iron Works, Baltimore, has published a loose-leaf, illustrated booklet, in which cranes and crane parts made by the company are described and illustrated. Chapters are devoted to crane trolleys, electric brakes, mechanical load brakes, bottom blocks, magnet cable drums, box girders, girders and drive, foot brakes, operators' cages and switchboard and various other parts of the crane. Each part described is accompanied by an illustration, and the latter part of the booklet is devoted to illustrations of working installations.

GEARS.—R. D. Nuttall Co., Chicago, has issued a booklet containing data on gears for tractor service. A number of illustrations are given, showing the various stages of gear manufacture, such as meshing a gear with a master gear to determine whether the centers are correct and teeth accurately set; giving bevel gear the running test; determining resistance of gears to abrasion; determining the hardness of gears after heat treatment, etc. Other illustrations are jackshaft transmission with cover removed; live-axle transmission with cover removed; live-axle transmission unit ready to be installed in a tractor; jackshaft transmission for use with bull-gear and illustrations of gear-tooth fractures showing the uniform close-grained structure of the gear teeth.

INDUSTRIAL TRACTORS.—An 18-page booklet has been prepared by the Mercury Mfg. Co., Chicago, in which tractors for use in manufacturing plants, warehouses, etc., are described and illustrated. These tractors are designed to pull trackless trailer trains without limitations as to pathway and can be used to either push or pull loads. They are driven by electric motors, which obtain current from storage batteries contained in the body of the tractor. According to the booklet, the power of these tractors in terms of draw-bar pull, varies from 600 to 1800 pounds, depending upon the power equipment. The illustrations show the tractors in actual operation at lumber yards, railroad stations, oil plants, tire manufacturing plants, foundries, machine manufacturing plants, packing plants and mail order houses.

STANDARD BUILDINGS.—The Austin Co., Cleveland, industrial engineer and builder, is circulating a large illustrated catalog, in which standard factory buildings which it designs and constructs, are described and illustrated. According to the booklet, the company erects permanent and substantial factory buildings in the fewest number of working days, eliminating by standardization and quantity production, delays which are otherwise unavoidable. Summed up the booklet contains an explanation of the company's method of factory construction, including engineering data, illustrations and descriptions of the 10 types of standard factory buildings which it builds, as well as a presentation of the company's industrial building service for the design, construction and equipment of complete plants.